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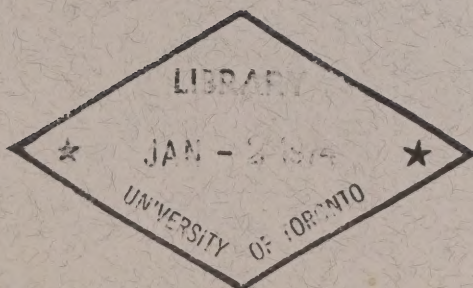
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Pacific Marine Science Report 73-1

Government
Publications

**Bibliography of Oceanographic Information for
the Inside Waters of the
Southern British Columbia Coast
Volume 1 - Physical Oceanography**

E.W. Marles



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BIBLIOGRAPHY OF OCEANOGRAPHIC INFORMATION

FOR THE INSIDE WATERS

OF THE

SOUTHERN BRITISH COLUMBIA COAST

VOLUME 1 - PHYSICAL OCEANOGRAPHY

by

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Environment Canada

February, 1973.

Introduction

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Introduction

Increasing requirements for oceanographic information from the Strait of Georgia and Juan de Fuca Strait for environment-oriented studies made it desirable to increase the accessibility of the great store of data already available. This bibliography of physical oceanographic information is the first of two volumes produced with this requirement in mind. The companion volume will be concerned with the biological oceanographic information of the same region.

Organization and Use of the Bibliography

The longest organized source of oceanographic data is the system of shore stations along the coast, usually established at lighthouses, which have been collecting data since 1914 in one location and since 1936 in several others within the study area. A list of these stations and their period of observation is presented with a chart of their locations.

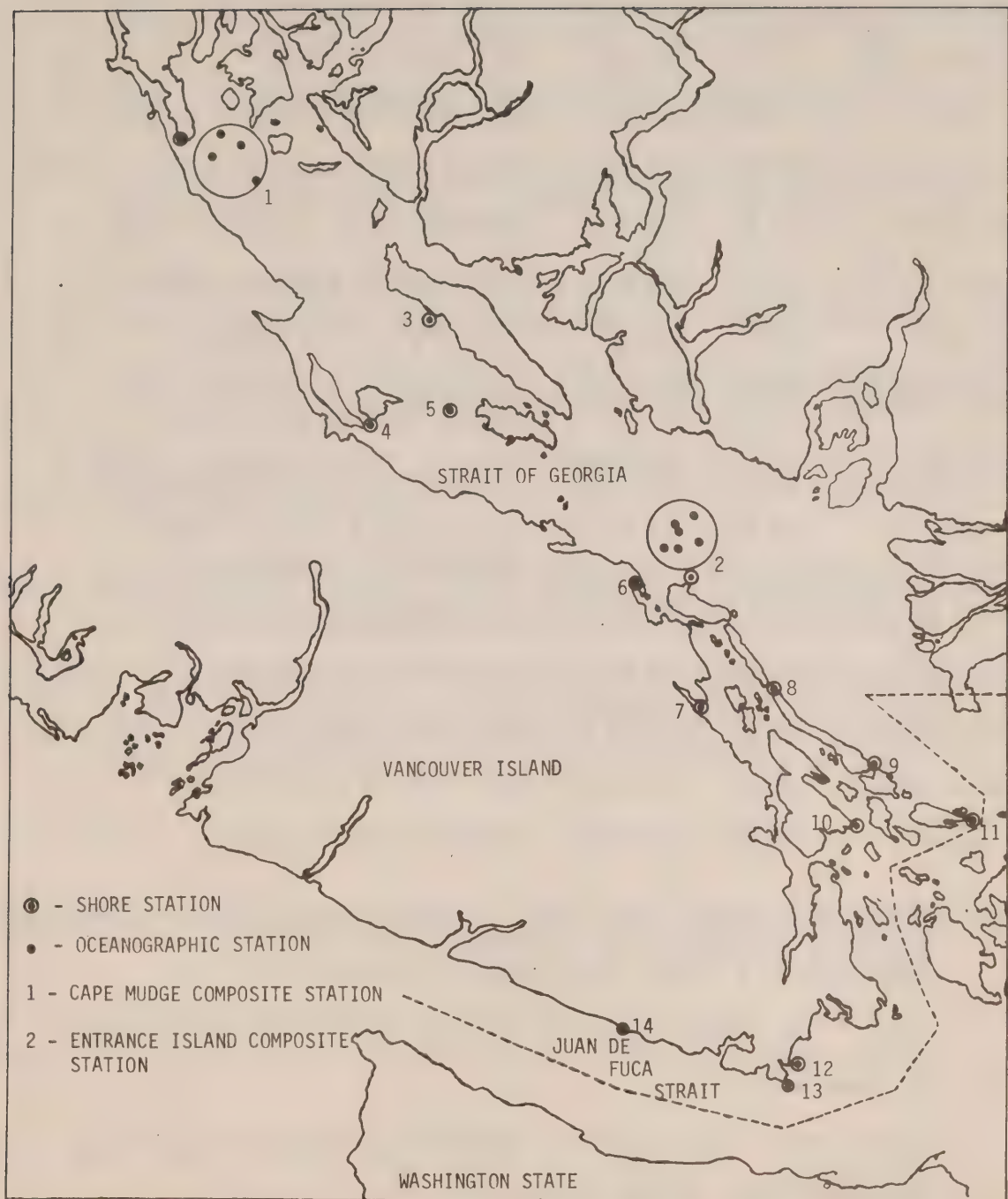
A graphic presentation of the cross-seasonal coverage of survey data in the Strait of Georgia and Juan de Fuca Strait has been produced. Track charts from these surveys, keyed to the bibliography, are included as a series of figures in the back of the manuscript.

Composite stations, constructed at two locations in the Strait of Georgia, are shown on the study area chart. The locations were chosen for the many samples taken in close proximity which could reasonably be considered as one station for accumulating time series data. These regions are near the shore stations at Entrance Island and Cape Mudge which have been collecting daily sea surface observations since June 1936 and January 1937 respectively. Stations collected from a number of data reports, in this fashion, can be used to show the seasonal and annual variation of physical oceanographic parameters. A graphic presentation of the cross-seasonal coverage of composite

station data is included.

Acknowledgements

Appreciation is due to Dr. J. F. Garrett for his review of the manuscript. The author would like to thank Dr. W. E. Johnson, Director, Fisheries Research Board of Canada Biological Station, Nanaimo, B. C., Dr. N. Balch, University of Victoria Department of Biology, Dr. G. L. Pickard, Institute of Oceanography, University of British Columbia, and Dr. E. E. Collias, University of Washington Department of Oceanography for their kind permission to reproduce track charts from the various manuscripts.



Inside Waters of the Southern British Columbia Coast - Station Locations

LIST OF SHORE STATIONS, LOCATIONS, AND PERIODS OF OBSERVATION.

STATION	LOCATION		PERIOD OF OBSERVATION	KEY NO.
	Lat. N.	Long. W.		
Sheringham Point	48 15'	123 55'	May 1968 to present	14
Race Rocks	48 18'	123 32'	May 1941 to present	13
William Head	48 20'	123 32'	January 1921 to June 1940	12
Beaver Point	48 46'	123 22'	November 1953 to December 1957	10
East Point	48 47'	123 03'	July 1953 to February 1968	11
Active Pass	48 52'	123 17'	February 1967 to present	9
Ladysmith Harbour	49 00'	123 49'	July 1936 to June 1942; August 1949 to March 1957	7
Porlier Pass	49 01'	123 35'	February 1967 to February 1972	8
Departure Bay	49 13'	123 57'	October 1914 to July 1932; June 1934 to present	6
Entrance Island	49 13'	123 48'	June 1936 to present	2
Chrome Island	49 28'	124 41'	April 1961 to present	4
Sisters Island	49 29'	124 26'	May 1968 to present	5
Texada Island	49 42'	124 33'	May 1953 to October 1956	3
Cape Mudge	50 00'	127 09'	January 1937 to present	1

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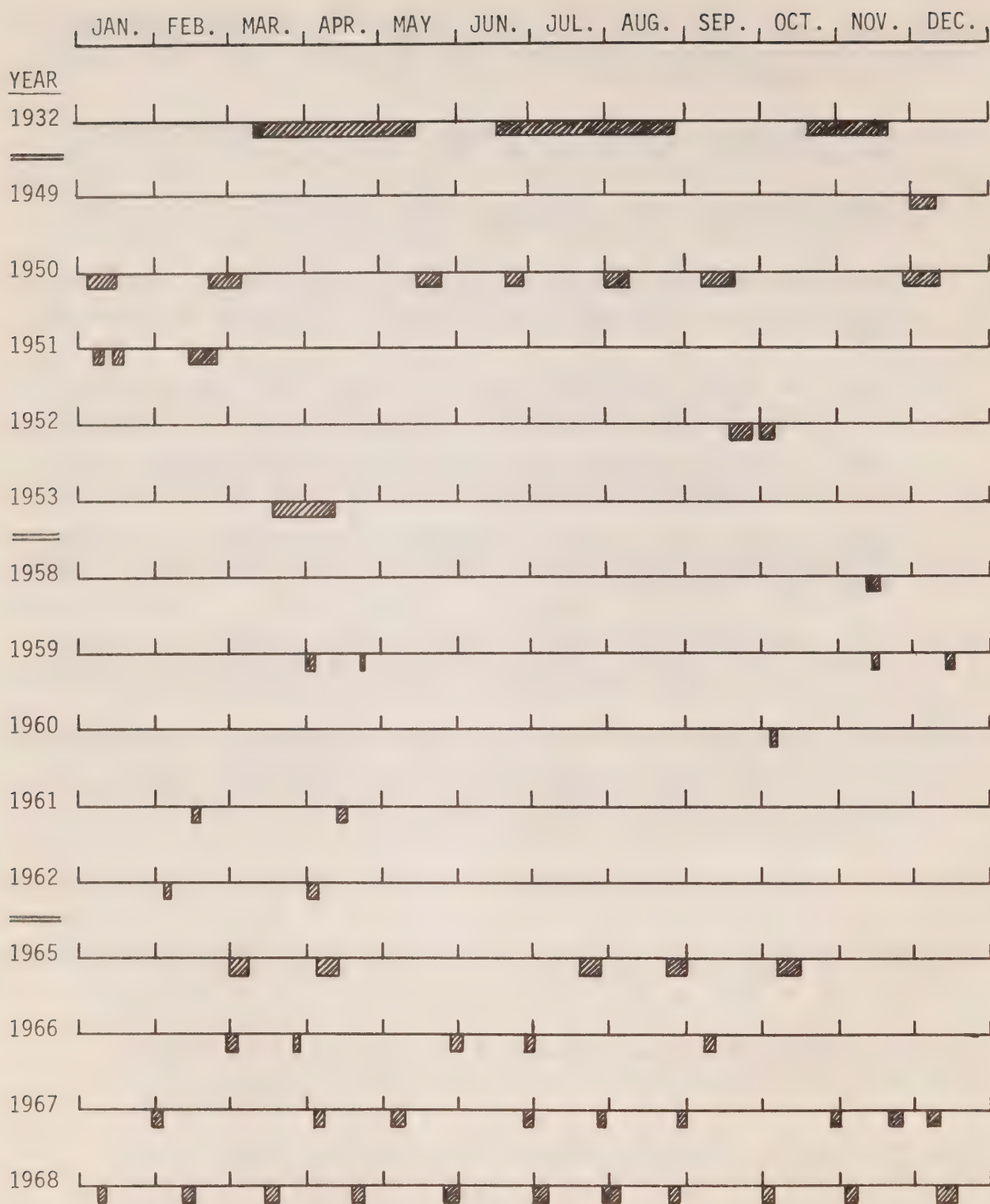
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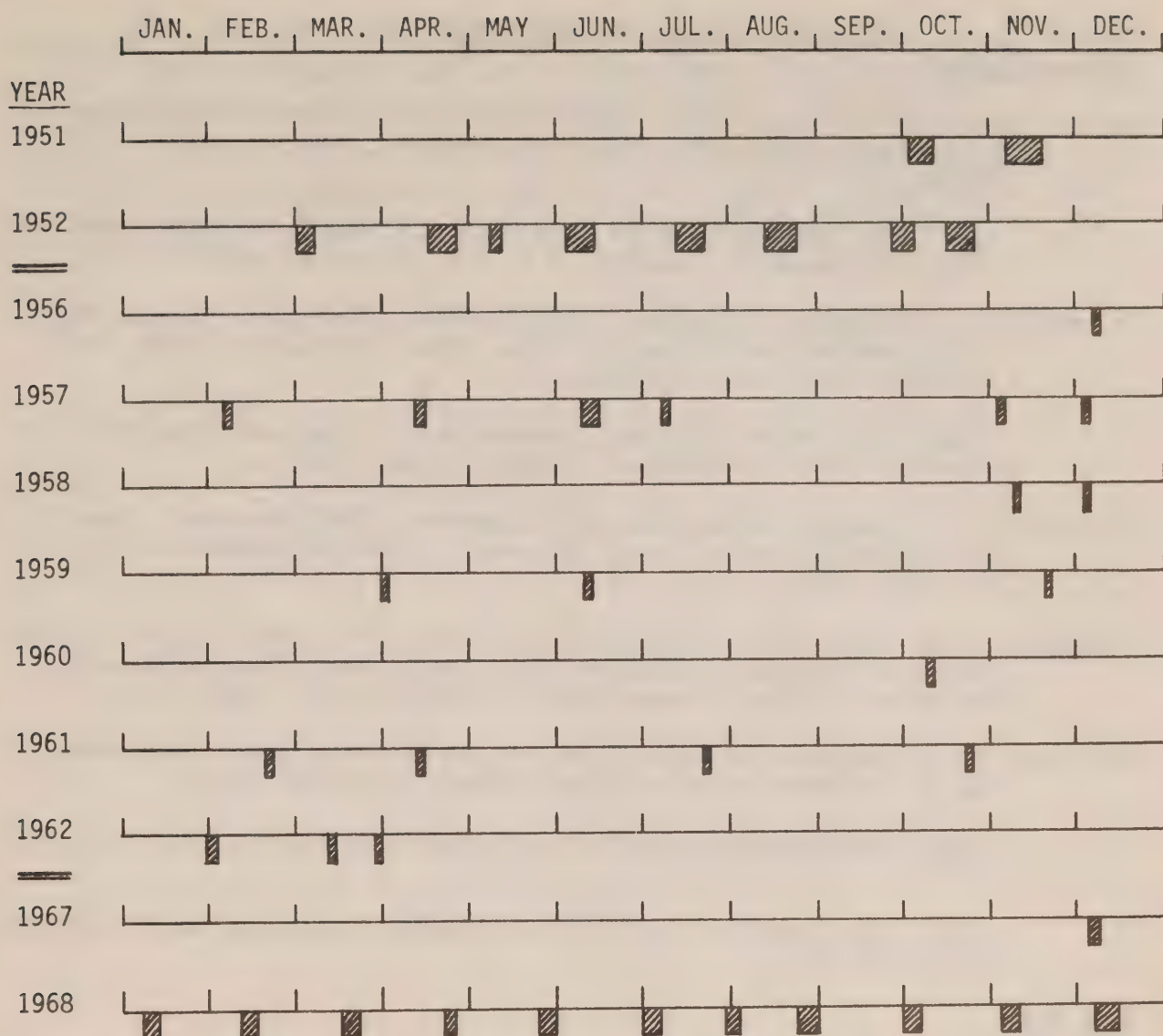
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Cross-seasonal Coverage of Survey Data in the Strait of Georgia

NB. Extent of Block Indicative of Cruise Dates Only, NOT Volume of Data.



Cross-seasonal Coverage of Survey Data in Juan de Fuca Strait

NB. Extent of Block Indicative of Cruise Dates Only, NOT Volume of Data.

Sources of Composite Station Data

Entrance Island

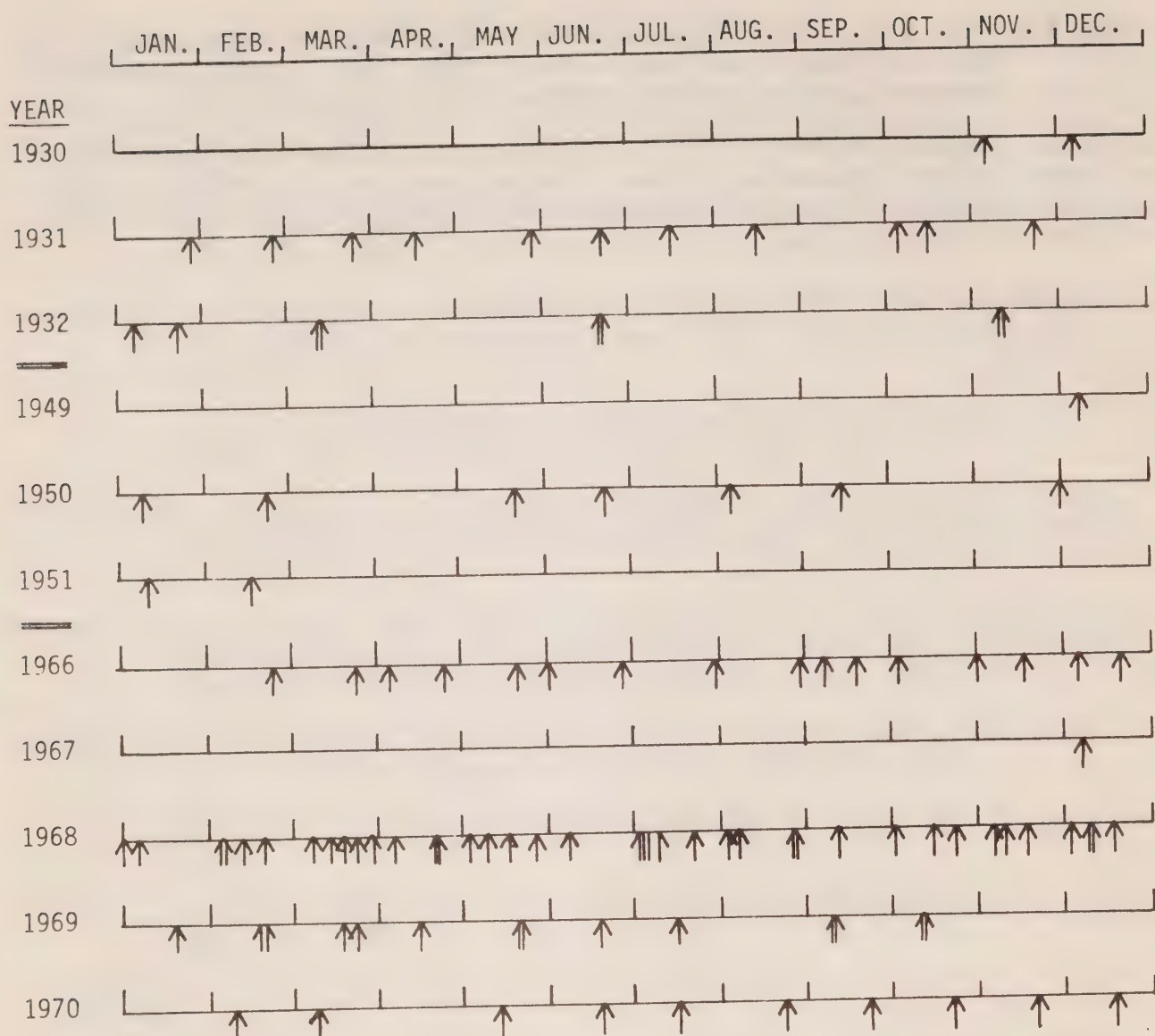
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Cape Mudge

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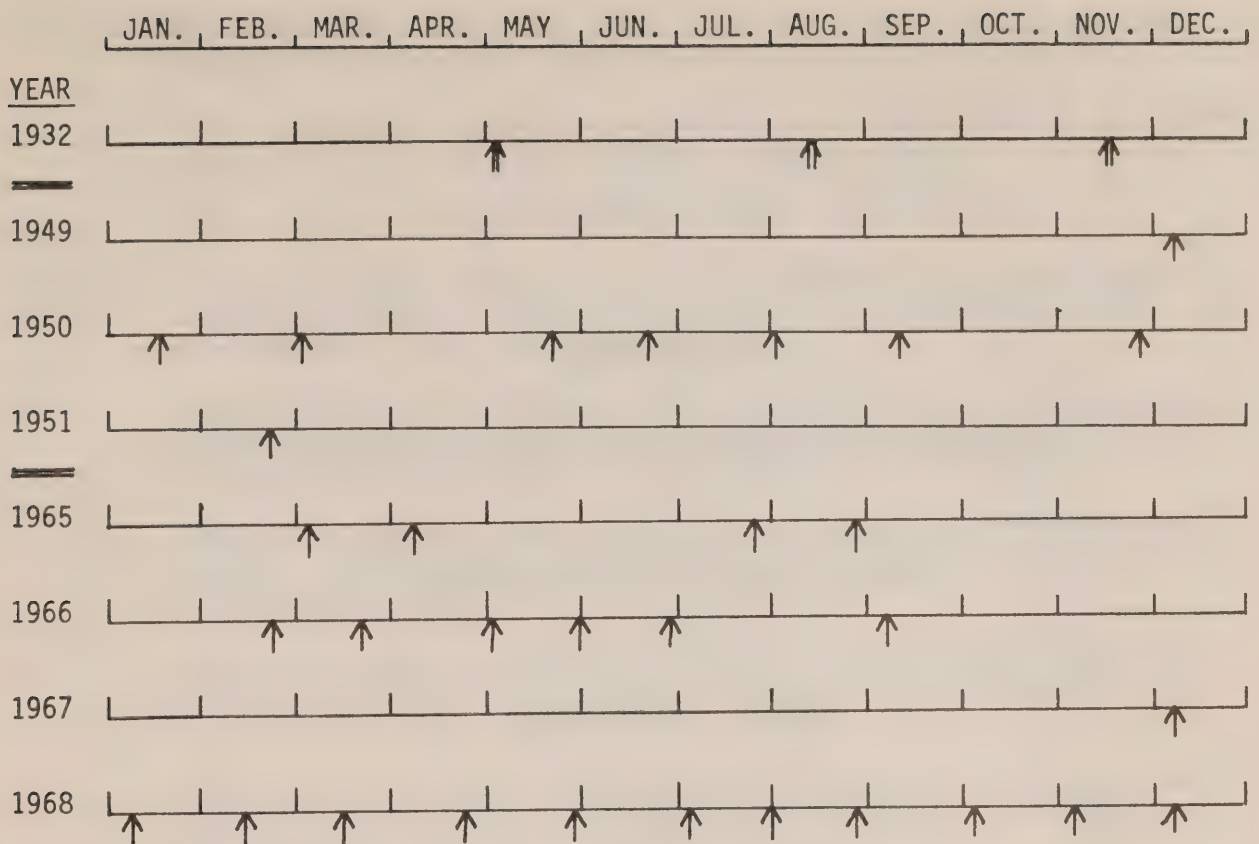
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Daily sea Surface temperature and salinity are also available in the vicinity of these long term composite stations. Precise locations and periods of observation for the Cape Mudge and Entrance Island stations are listed in the table of shore stations.



COMPOSITE CROSS-SEASONAL DATA - OFF ENTRANCE ISLAND, STRAIT OF GEORGIA

Daily sea surface temperatures and salinities are available from June 1936 to the present from the Entrance Island shore station.



COMPOSITE CROSS-SEASONAL DATA - OFF CAPE MUDGE, STRAIT OF GEORGIA

Daily sea surface temperatures and salinities are available from January 1937 to the present from the Cape Mudge shore station.

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Physical Oceanography

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- FRB Canada Ms. Rept. B - Fisheries Research Board of Canada, Manuscript Report Series, Biological
- FRB Canada Ms. Rept. - Fisheries Research Board of Canada, Manuscript Report Series
- FRB Canada Tech. Rept. - Fisheries Research Board of Canada, Technical Report Series
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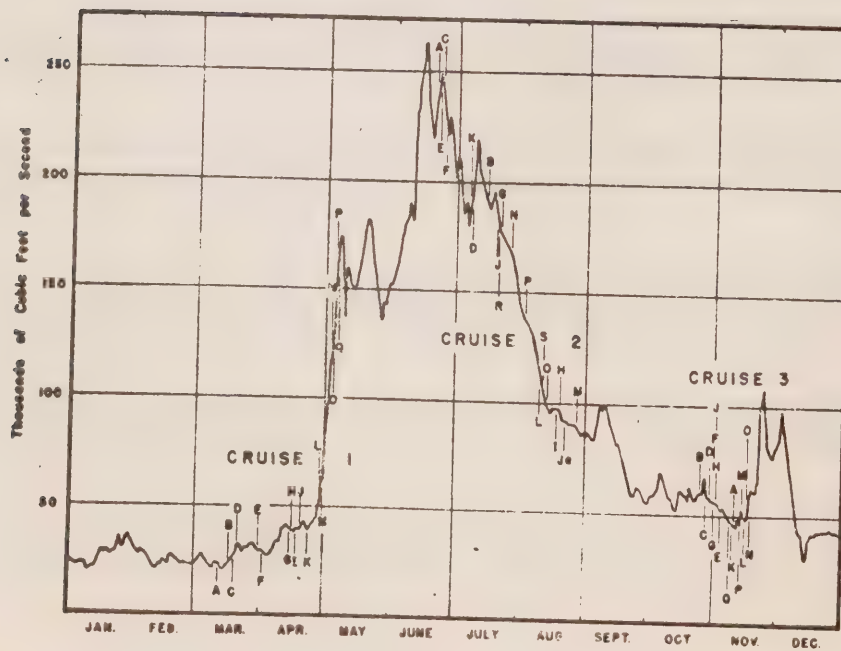
TRACK CHARTS

Physical Oceanography for the Inside Waters
of the
Southern British Columbia Coast

(Keyed to the Bibliography)



Oceanographic Stations in the Strait of Georgia, 1930, 1931, 1932



Dates of observations and discharge of the Fraser R. - 1932

Fig. - 1

Pacific Oceanographic Group. 1953. Physical and Chemical Data Record, Strait of Georgia, 1930, 1931, 1932. FRB Canada Ms., Nanaimo, B.C.

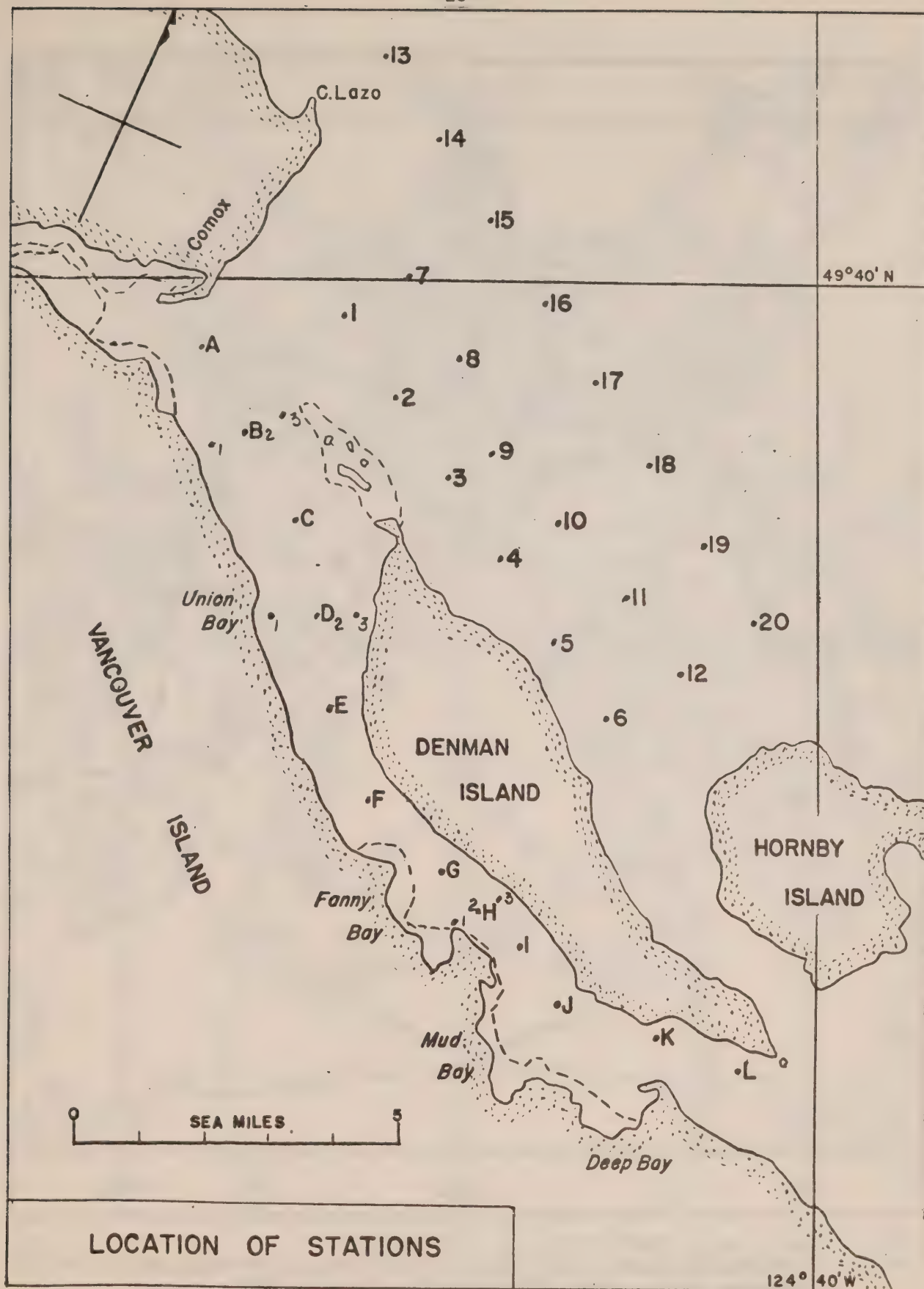


Fig. 2 Waldie, R.J. 1952. Winter Oceanography of Baynes Sound and the Lazo Bight. FRB Canada Ms. Nanaimo, B.C.

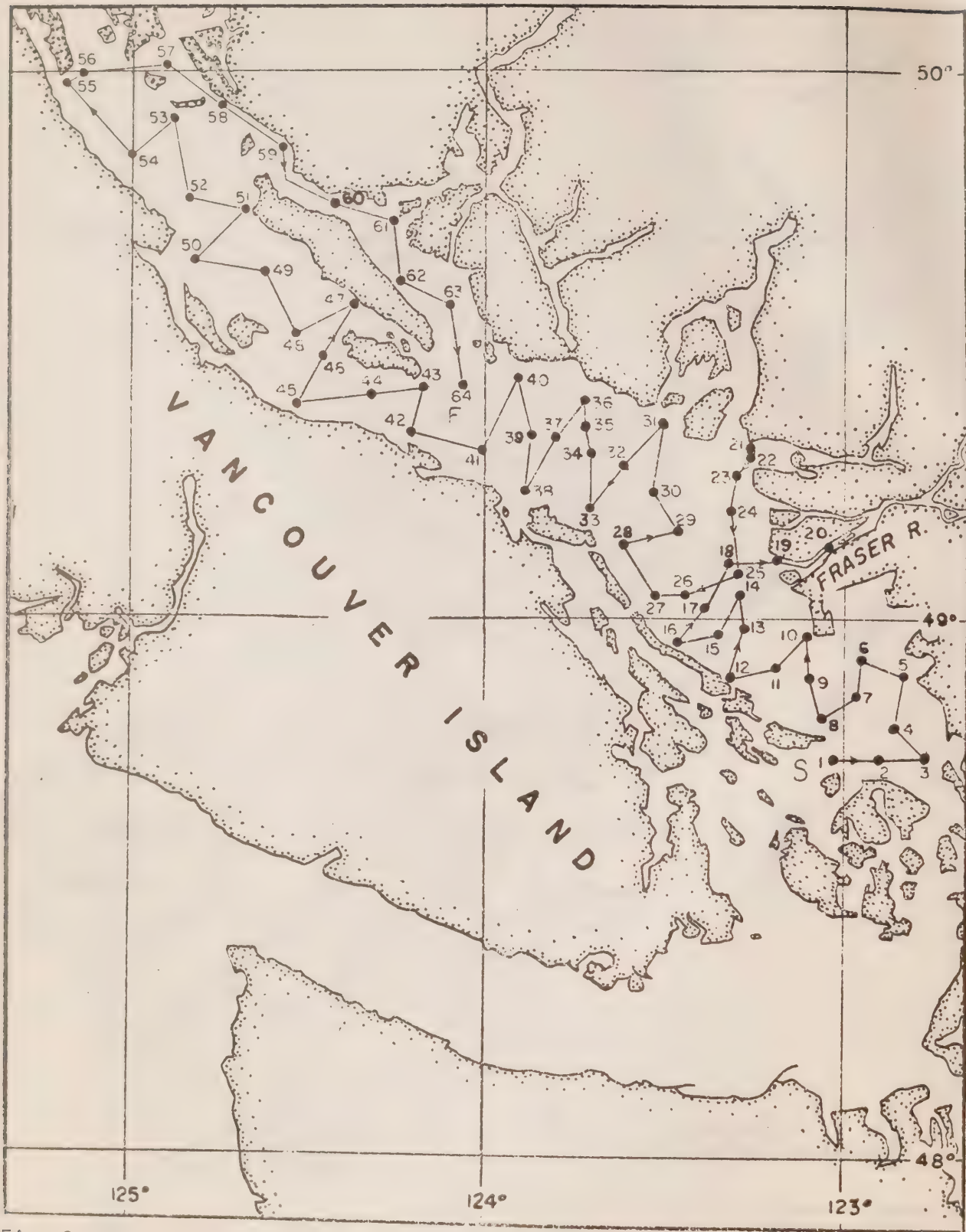


Fig. 3 (Dec. 1 to 8, 1949)
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Fig. 4 (January 9 to 17, 1950)
Pacific Oceanographic Group. 1954. Physical and Chemical Data Record, Strait of
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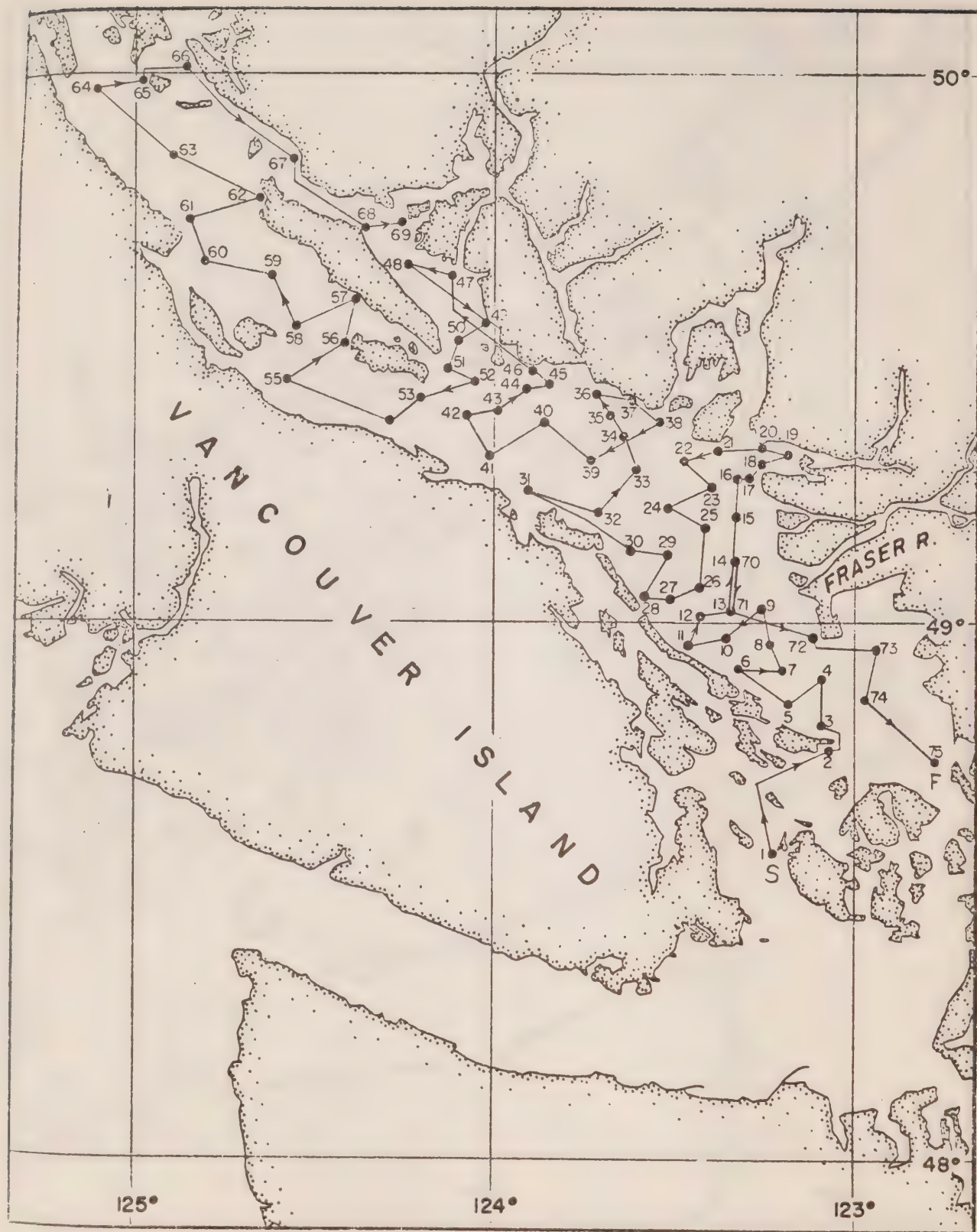


Fig. 5 (February 20 to March 3, 1950)
 Pacific Oceanographic Group. 1954. Physical and Chemical Data Record, Strait of
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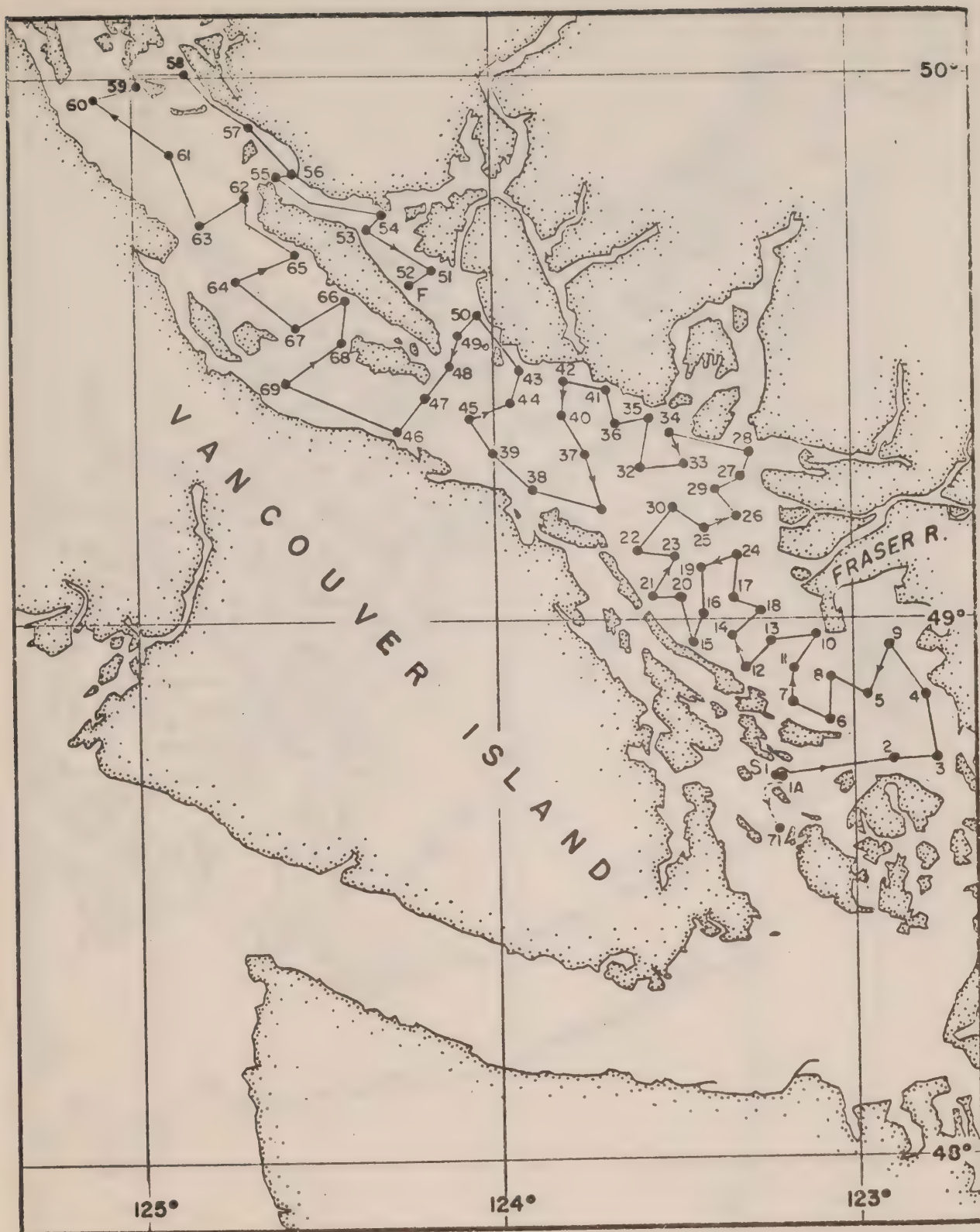


Fig. 6 (May 15 to 22, 1950)
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Fig. 7 (June 19 to 26, 1950)
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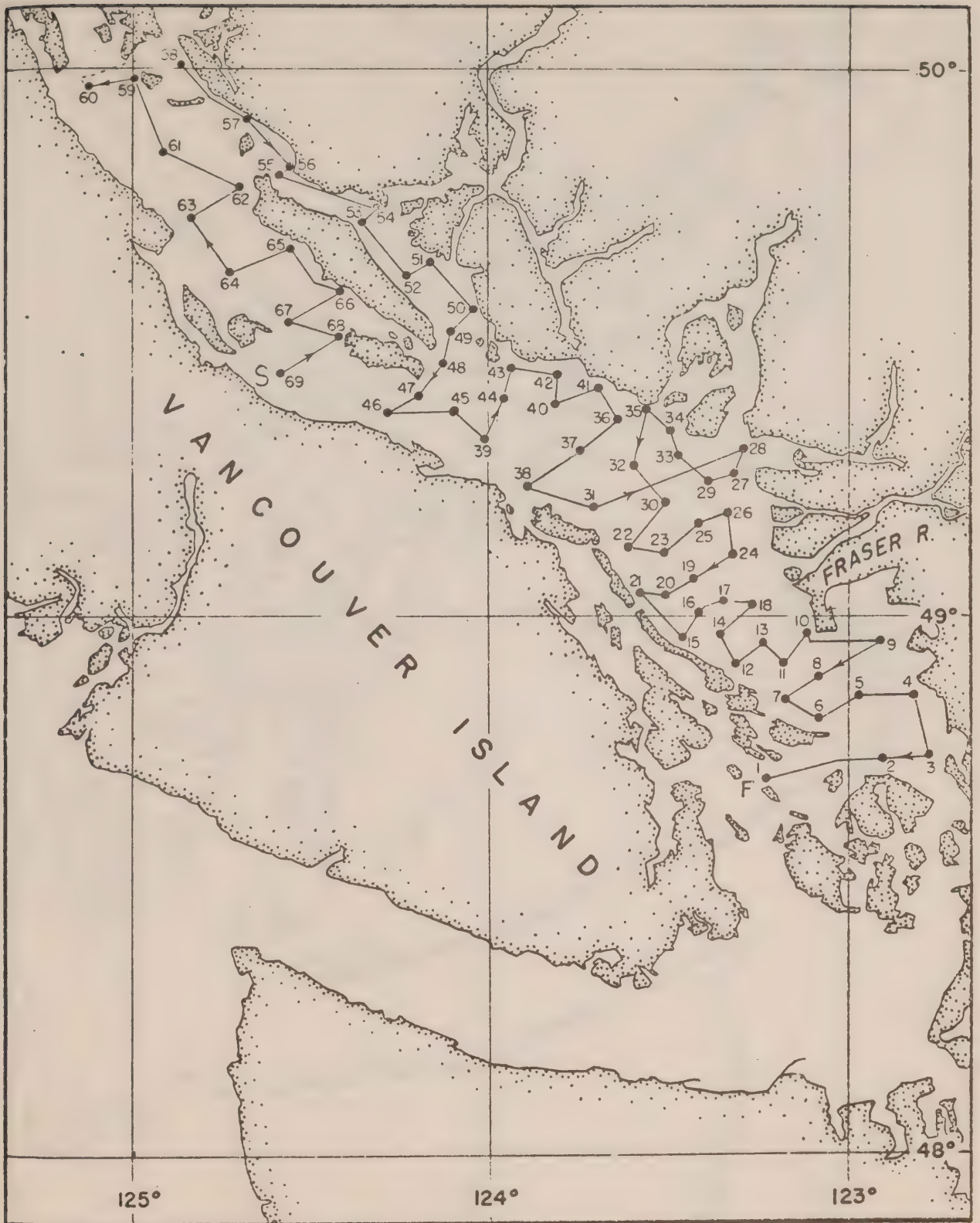


Fig. 8 (July 31 to August 8, 1950)
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Fig. 9 (September 5 to 15, 1950)
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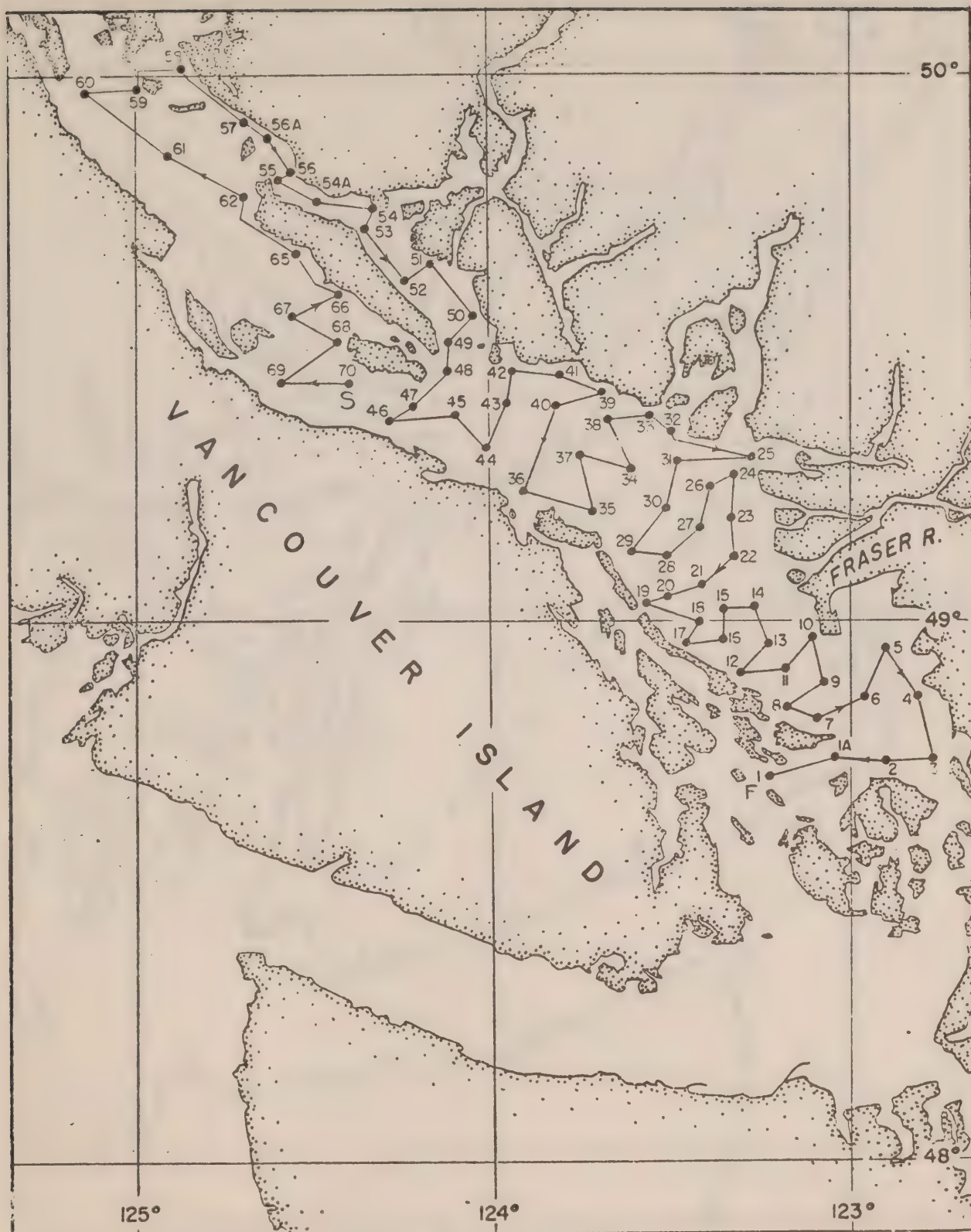


Fig. 10 (November 28 to December 5, 1950)
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Fig. 11 (January 8 to 10, 1951)
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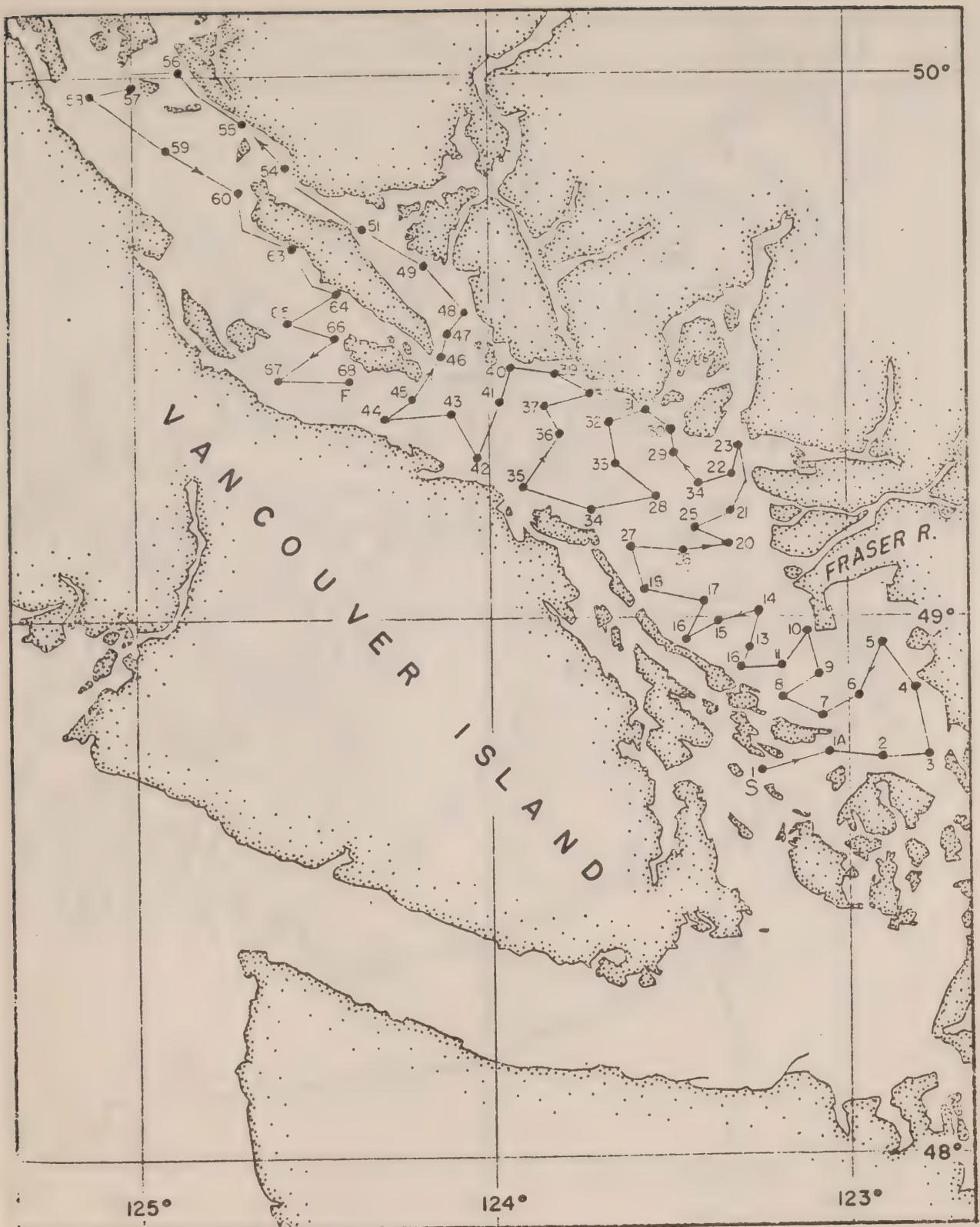


Fig. 12 (February 14 to 23, 1951)
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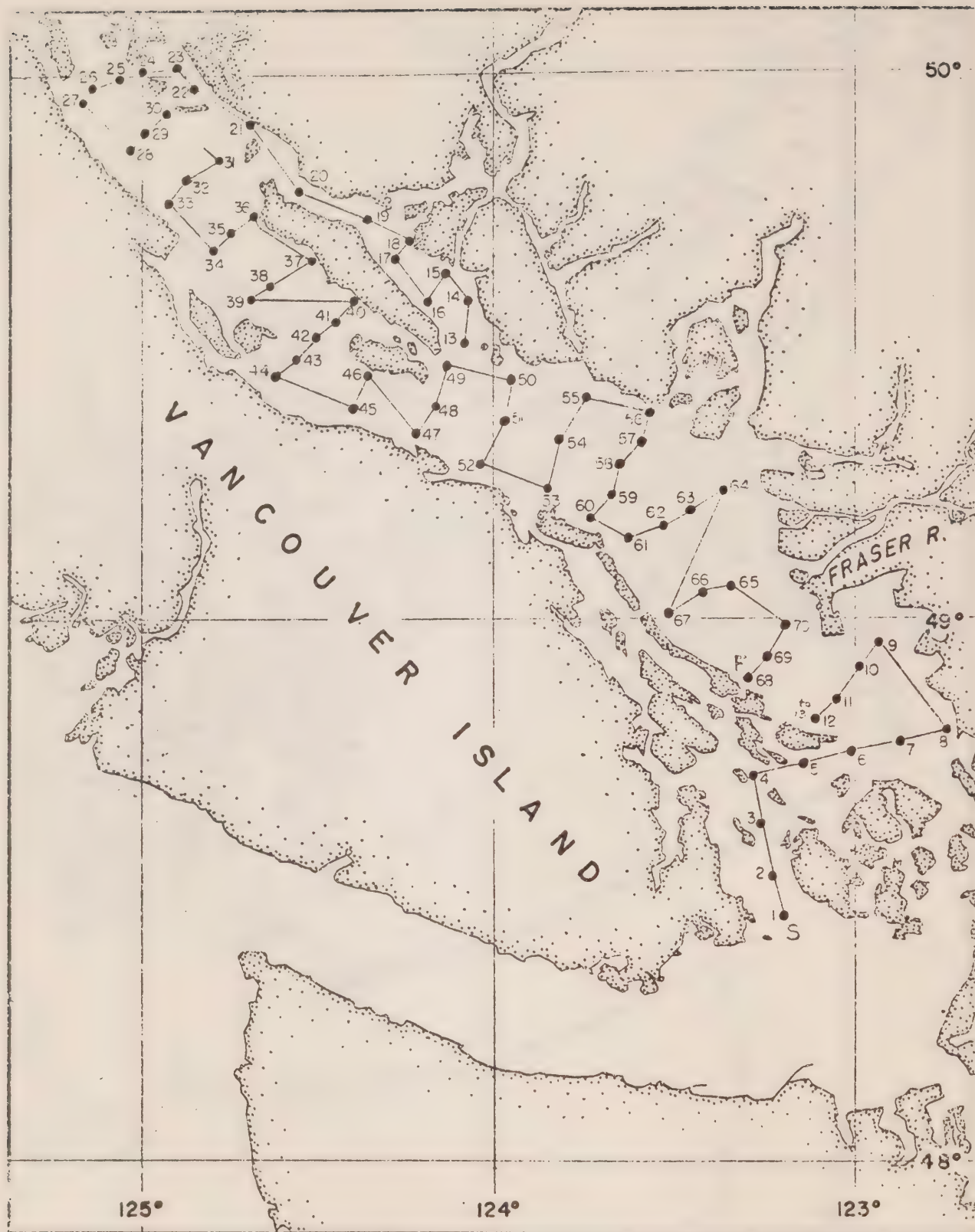


Fig. 13 (September 22 to 26, 1952)
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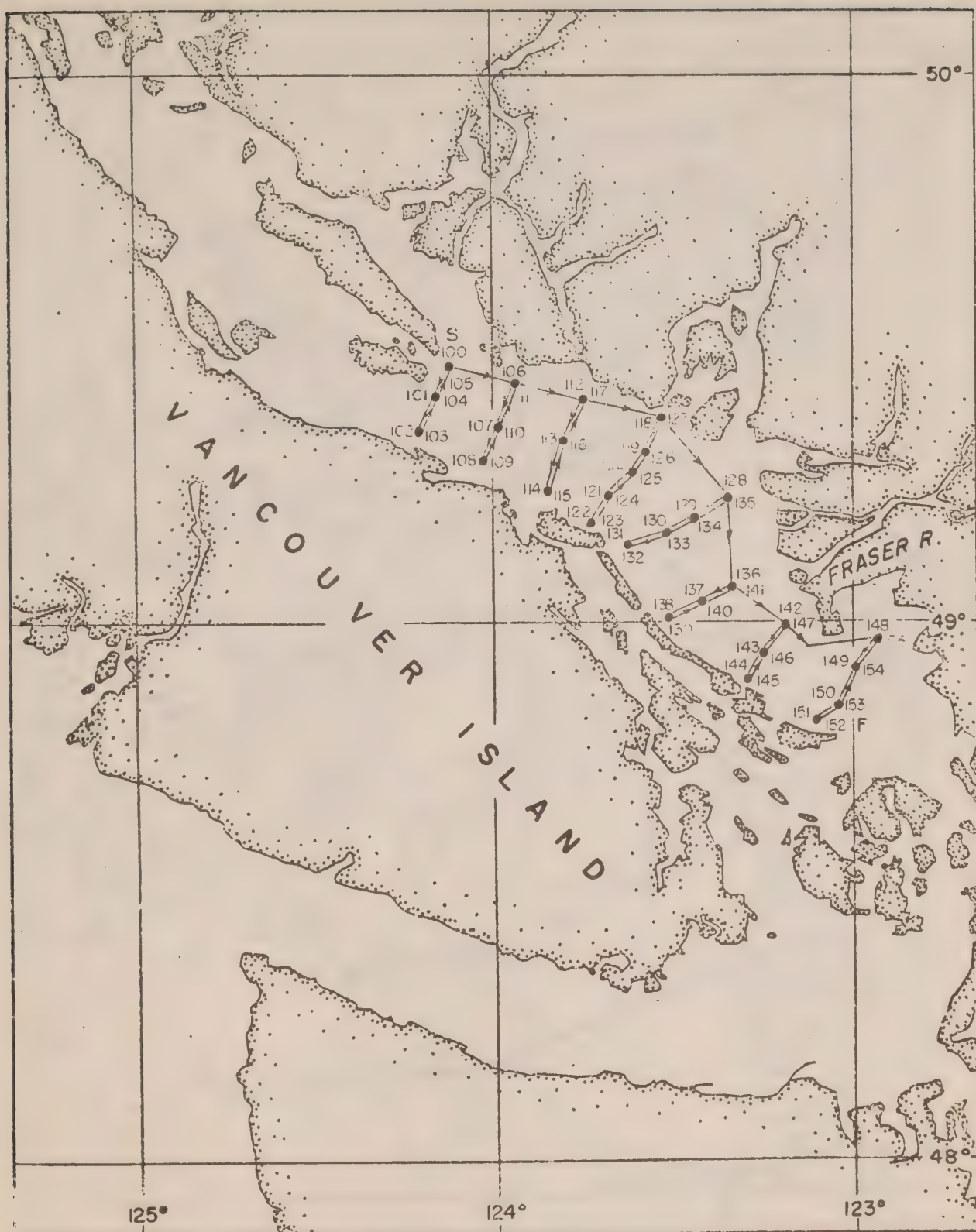


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 Pacific Oceanographic Group. 1954. Physical and Chemical Data Record, Strait of
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Fig. 15 (March 16 to April 10, 1953)
 Pacific Oceanographic Group. 1954. Physical and Chemical Data Record, Strait of
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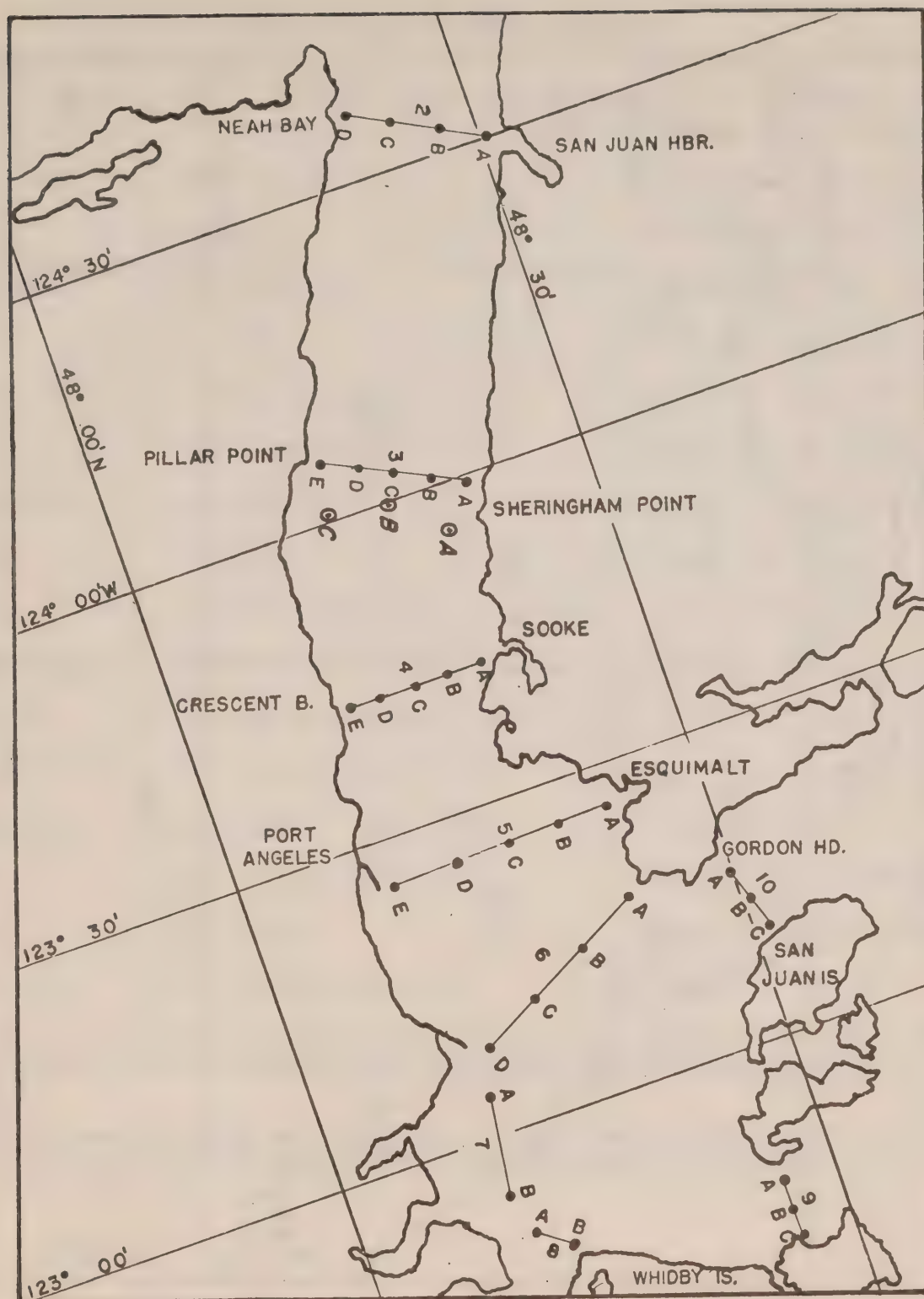


Fig. 16
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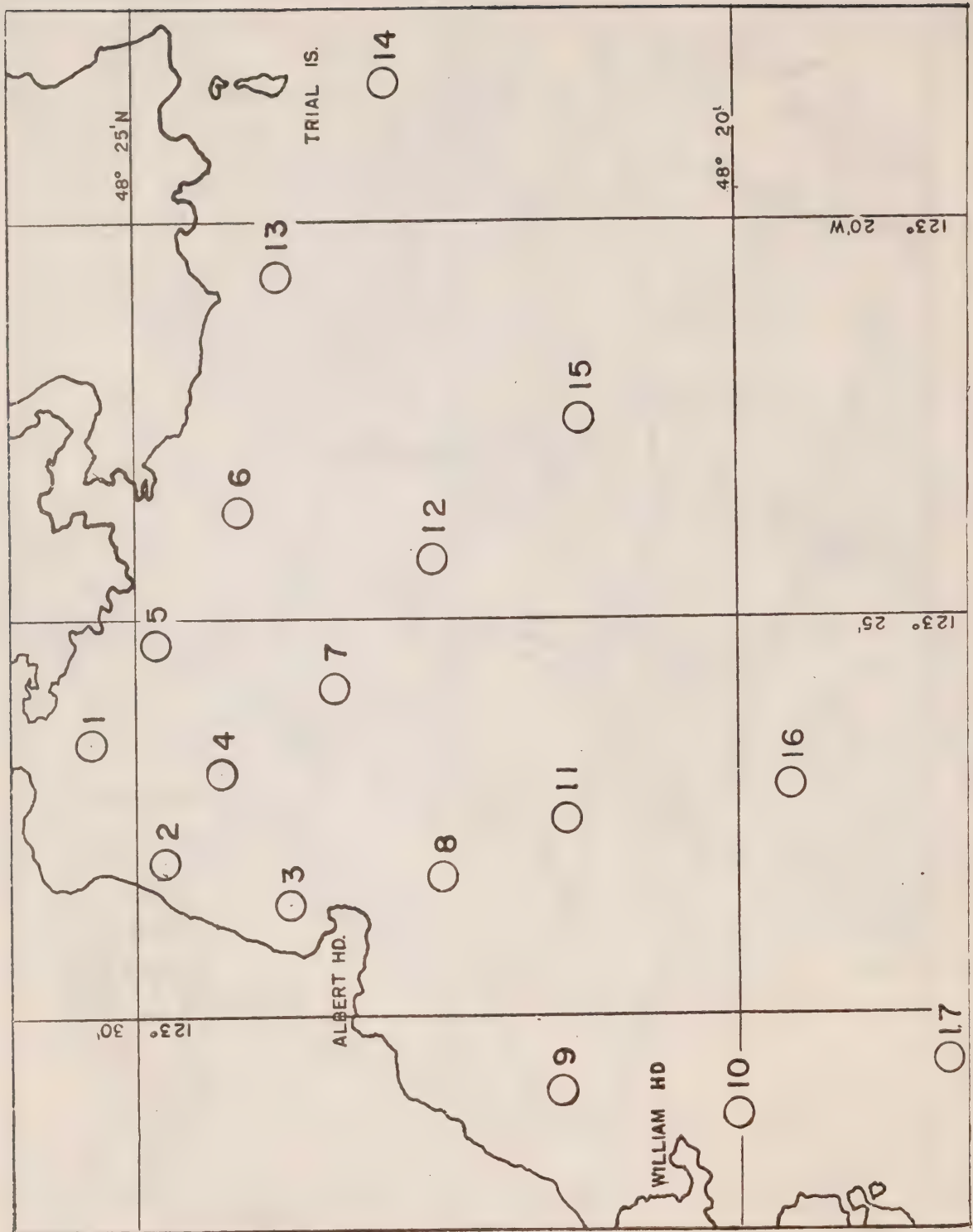


Fig. 17 Approaches to Esquimalt Harbour
 Pacific Oceanographic Group. 1955. Physical and Chemical Data Record, Juan de Fuca Strait Project, 1951 - 1952. FRB Canada Ms. Nanaimo, B.C.

Index of Oceanographic Stations

Cruise	Lines of Stations	Time Period
I	All Lines	October 2 to 13, 1951
ESQ. HBR.	All Stations	October 16 - 19, 1951 Oct. 31 - Nov. 1, 1951
II	All Lines	November 5 - 17, 1951
ESQ. HBR.	All Stations	November 20 - 23, 1951
III	All Lines	Feb. 28 - March 8, 1952
IV	Current Measurement Line 3	March 11 - 21, 1952
V	All Lines except 9 & 10	April 16 - 25, 1952
ESQ. HBR.	All Stations	April 29 - May 2, 1952
VI	6, 7, 8, 9, 10	May 6 - 8, 1952
VII	All Lines except 9	June 3 - 13, 1952
ESQ. HBR.	Stations 1 - 6 inclusive	June 19, 1952
VIII	Current Measurement Line 3	July 2 - 7, 1952
IX	All Lines except 2 & 3	July 10 - 17, 1952
ESQ. HBR.	Stations 1 - 9 inclusive	July 14, 1952
X	All Lines except 3	August 13 - 20, 1952
XI	All Lines	Sept. 23 - Oct. 2, 1952
ESQ. HBR.	All Stations except 17	October 7 - 8, 1952
XII	Current Measurement Line 3	October 15 - 23, 1952

Fig. 18

Pacific Oceanographic Group. 1955. Physical and Chemical Data Record, Juan de Fuca Strait Project, 1951 - 1952. FRB Canada Ms. Nanaimo, B.C.

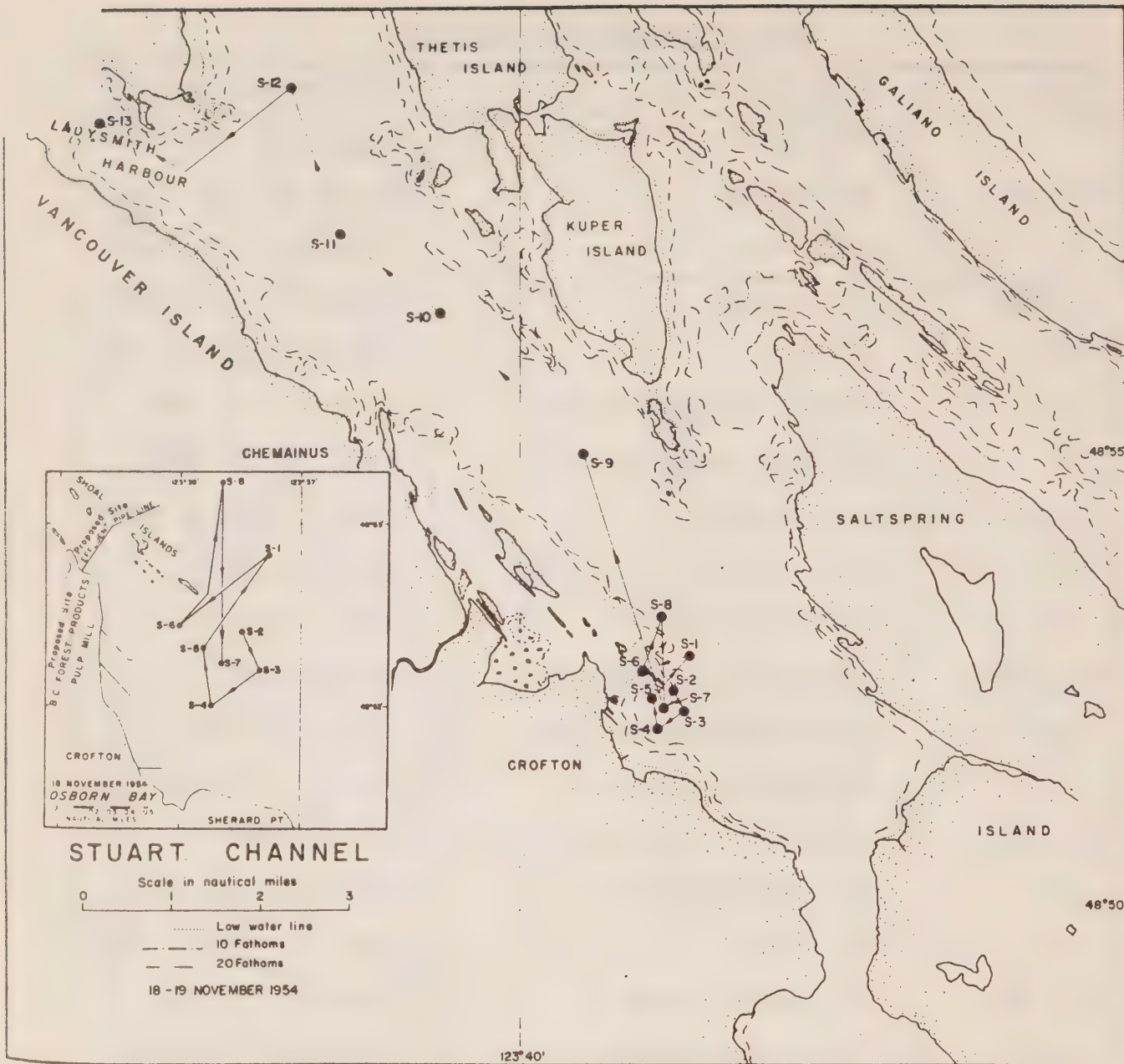


Fig. 19

(November 18 - 19, 1954)

Waldichuk, M., J.H.Meikle and J.R.Markert. 1968. Physical and Chemical Oceanographic Data from the East Coast of Vancouver Island, 1954 - 1966. FRB Canada Ms. Rept. 989.

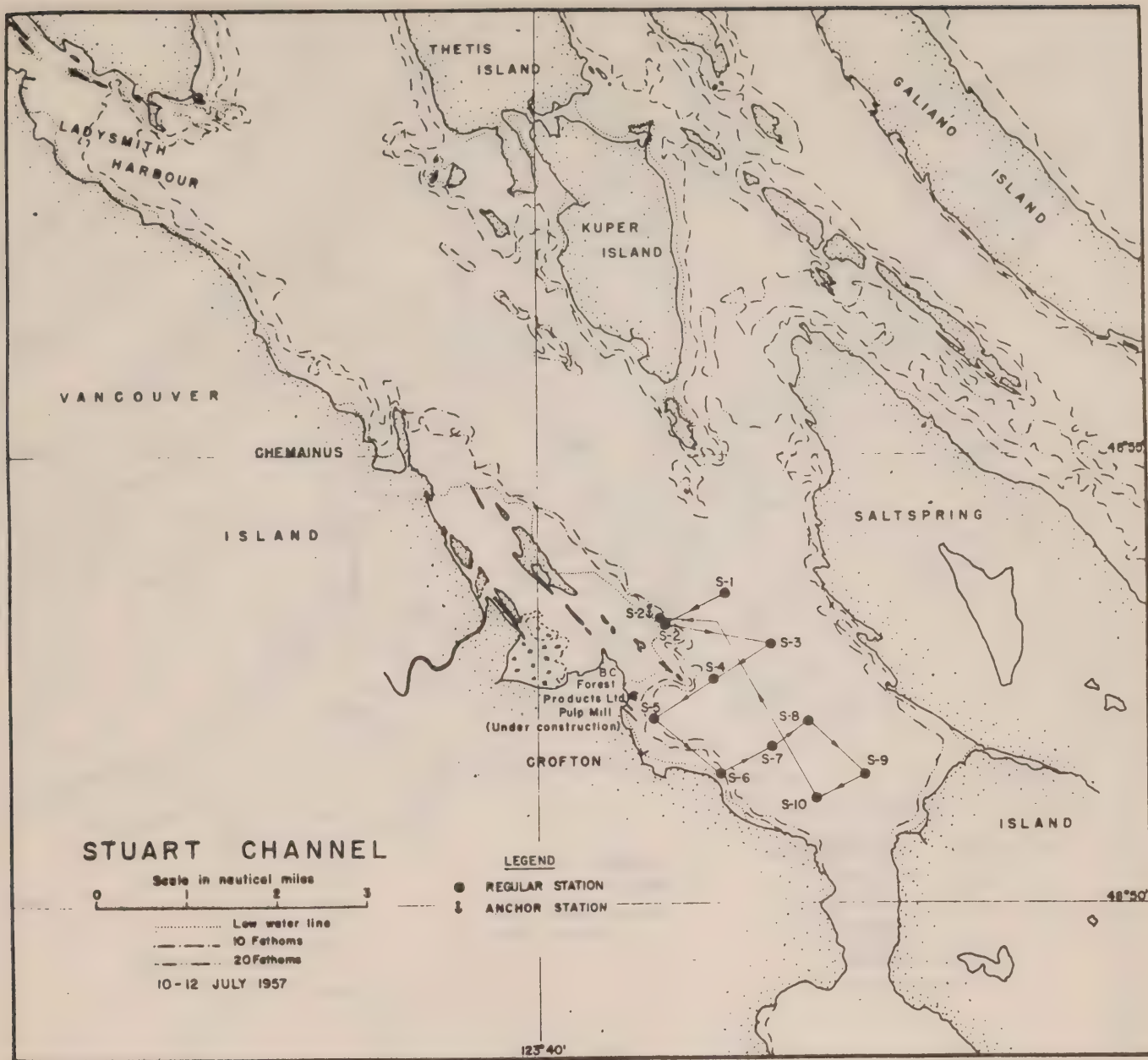


Fig. 20

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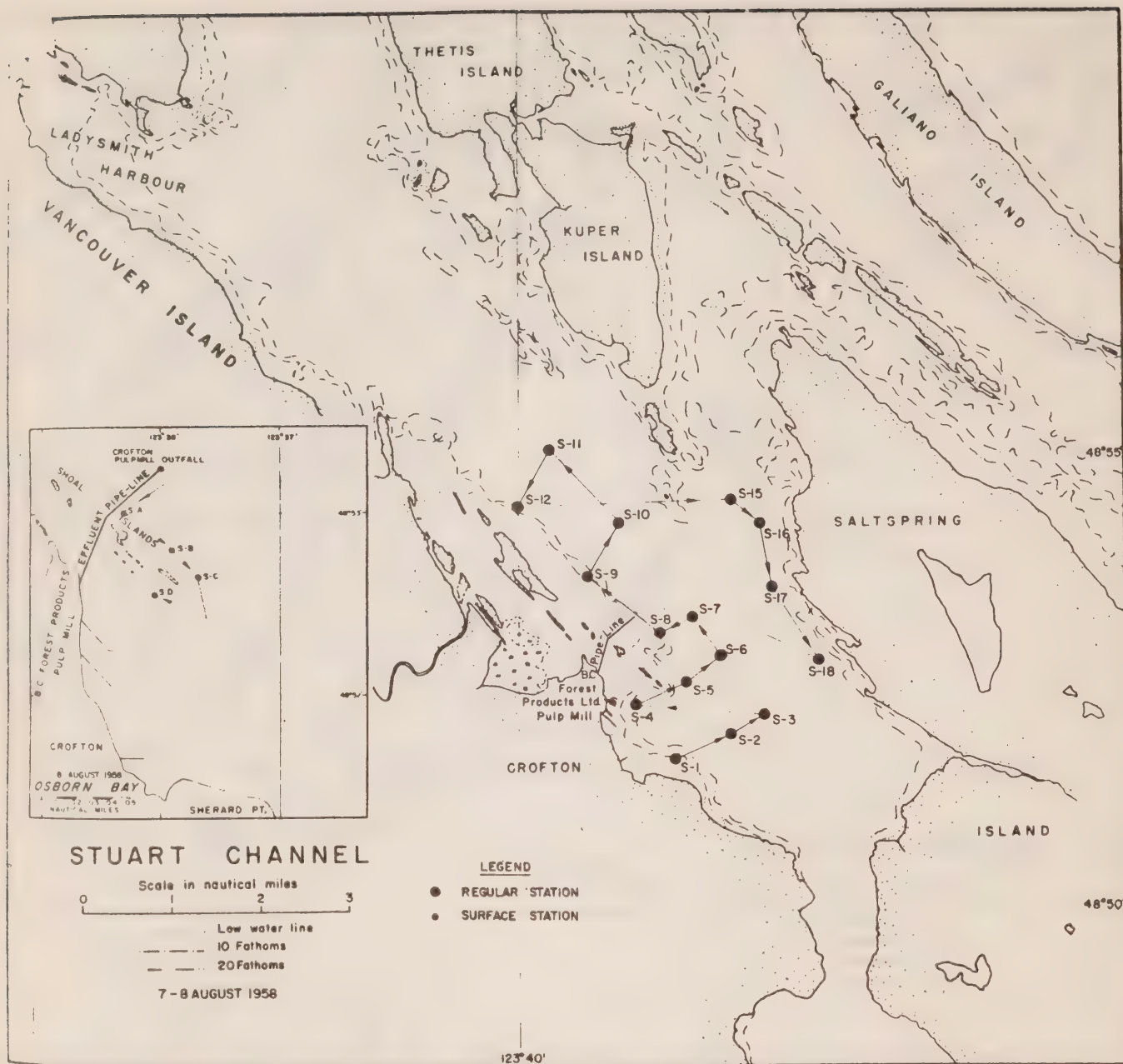


Fig. 21 (August 7 - 8, 1958)

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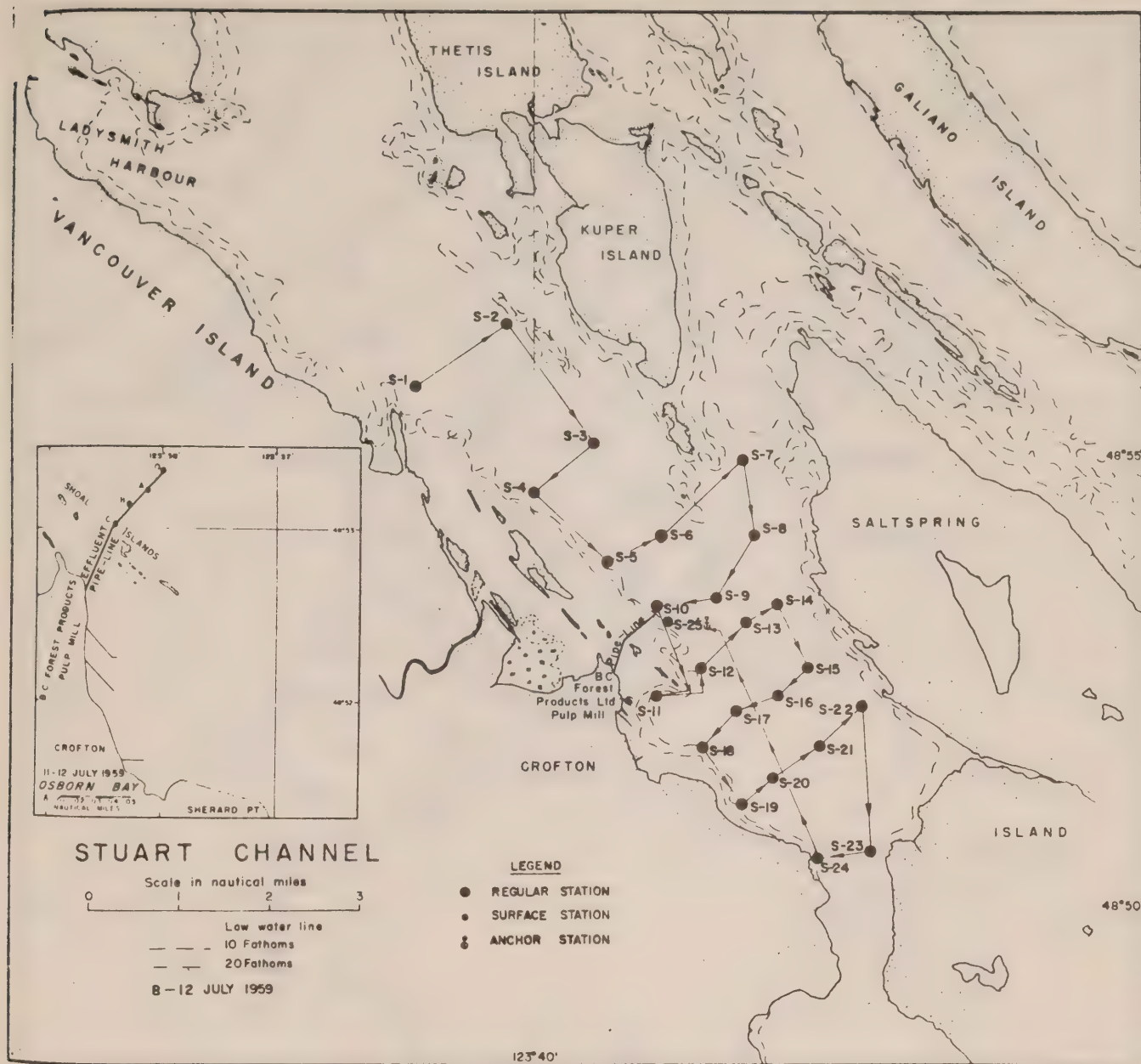


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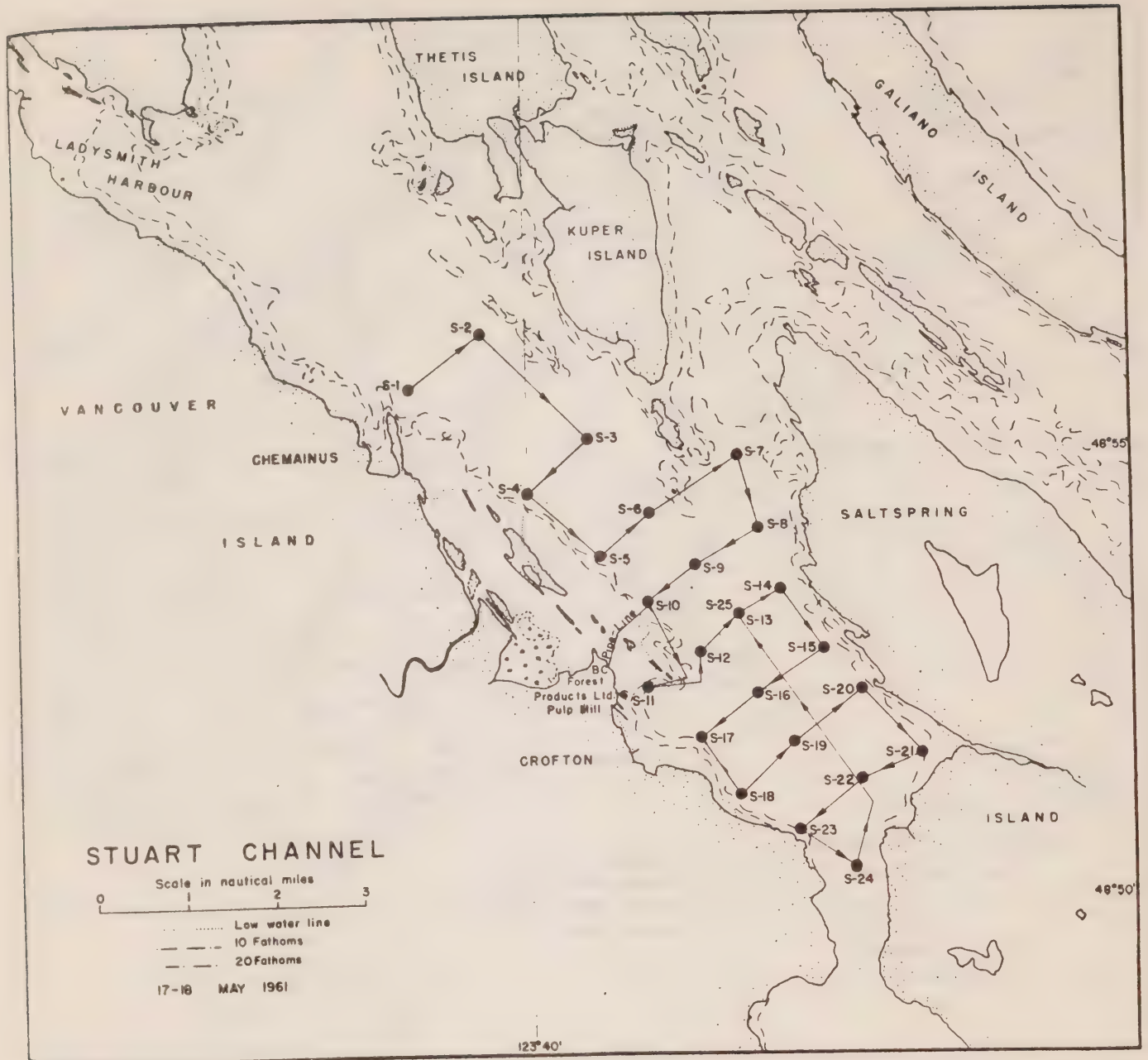


Fig. 23

(May 17 - 18, 1961)

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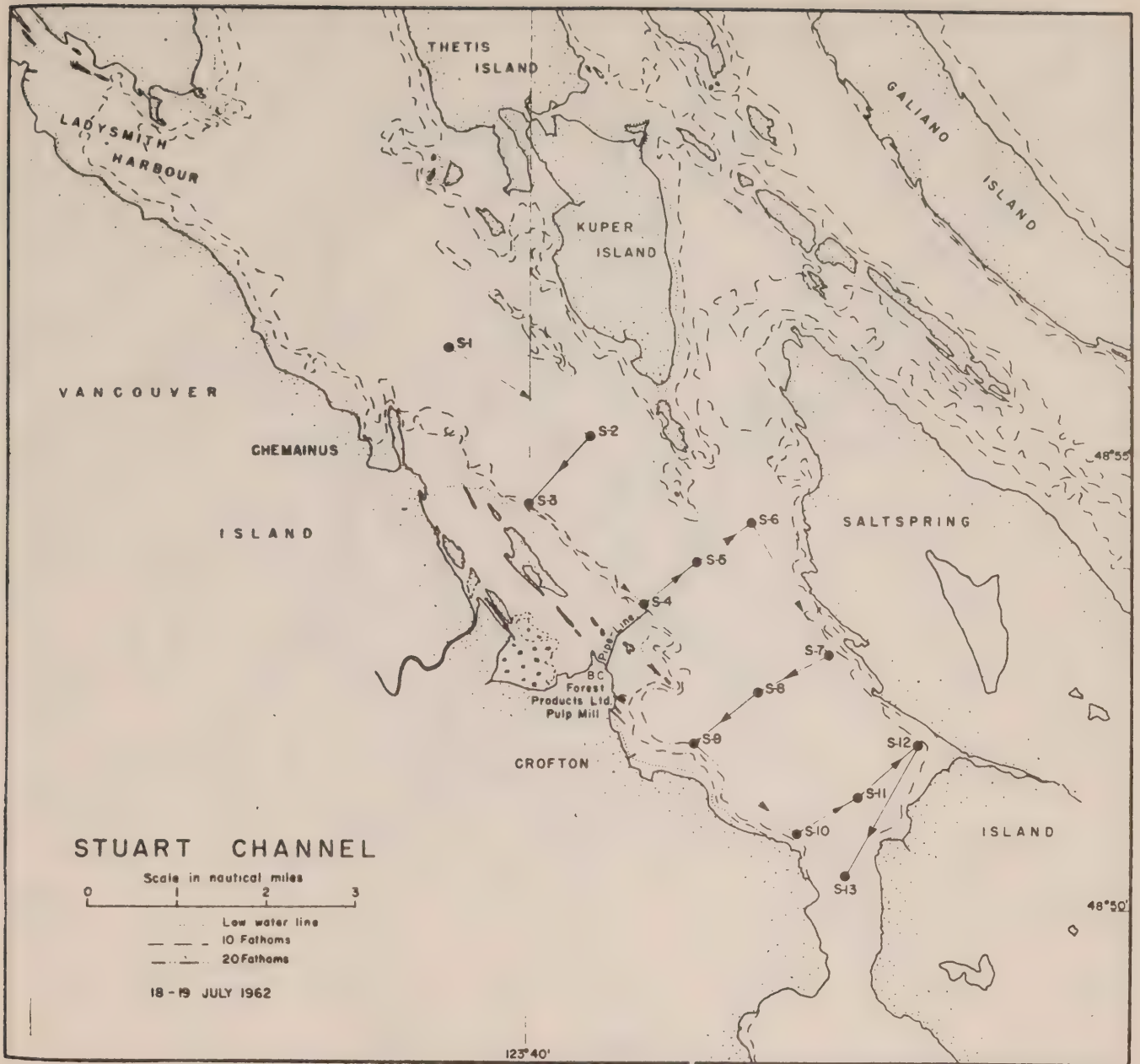


Fig. 24 (July 18 - 19, 1962)

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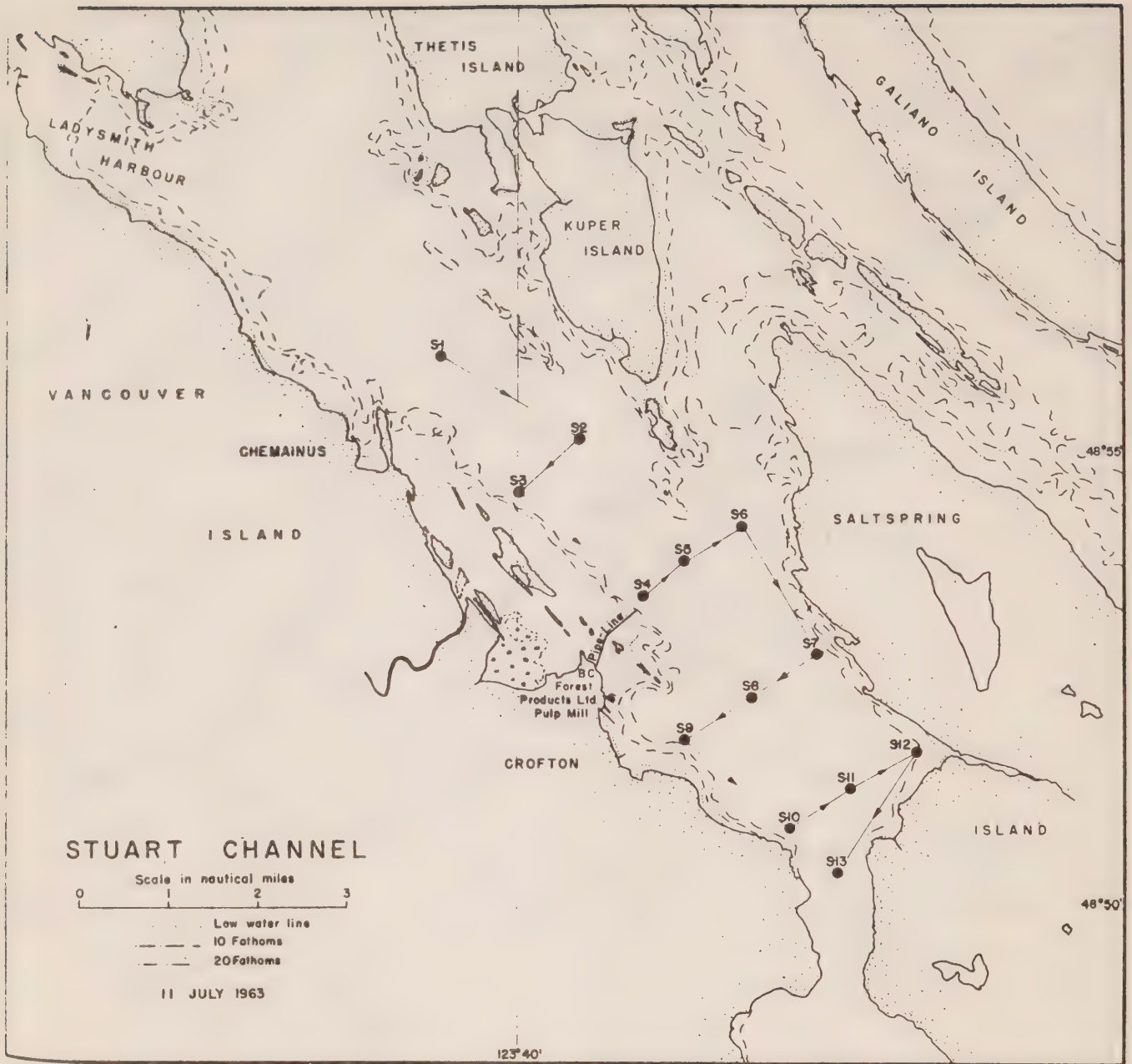


Fig. 25

(July 11, 1963)

Waldichuk, M., J.H. Meikle and J.R. Markert. 1968. Physical and Chemical Oceanographic Data from the East Coast of Vancouver Island, 1954 - 1966. FRB Canada Ms. Rept. 989.

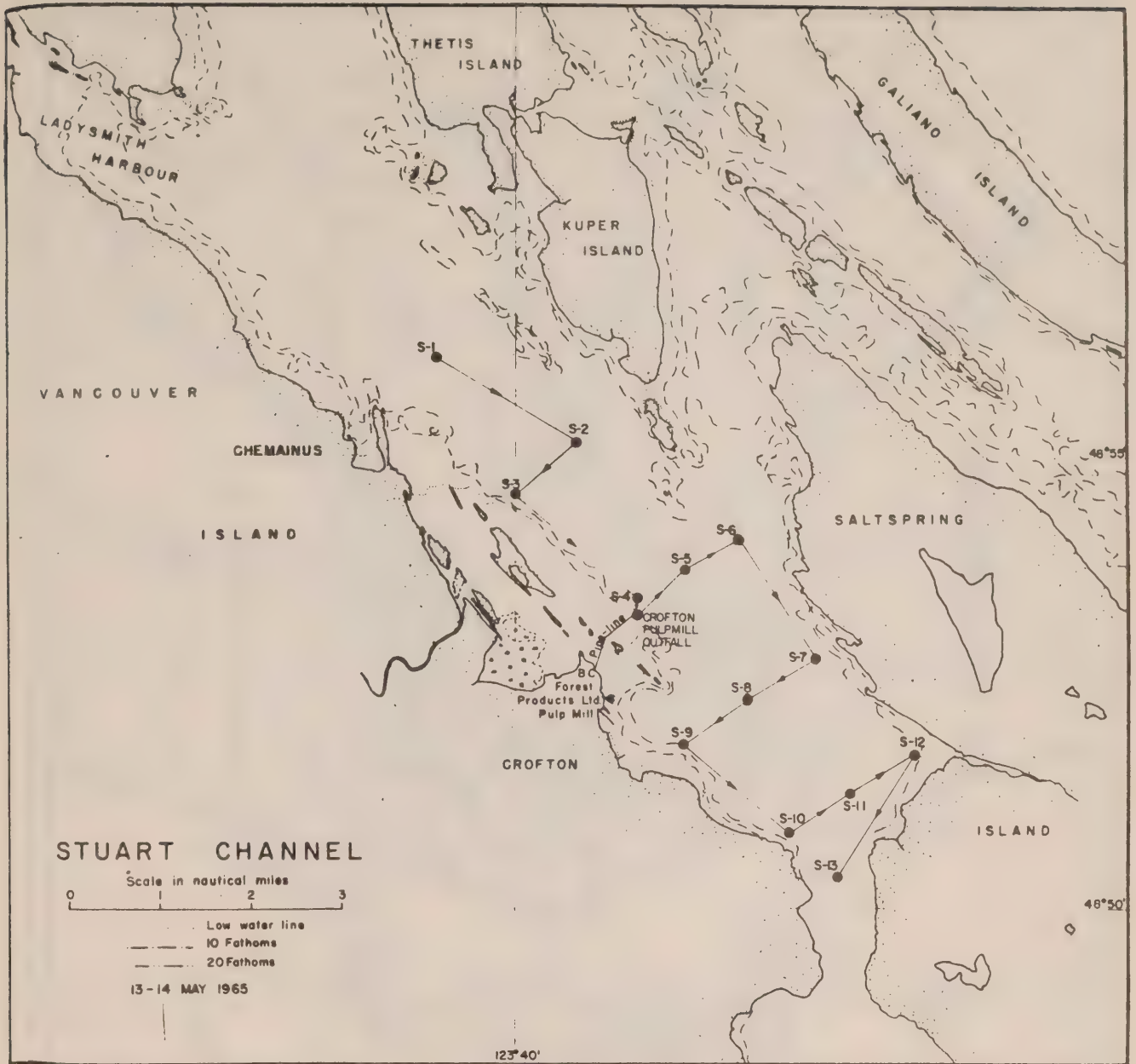


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(May 13 - 14, 1965)

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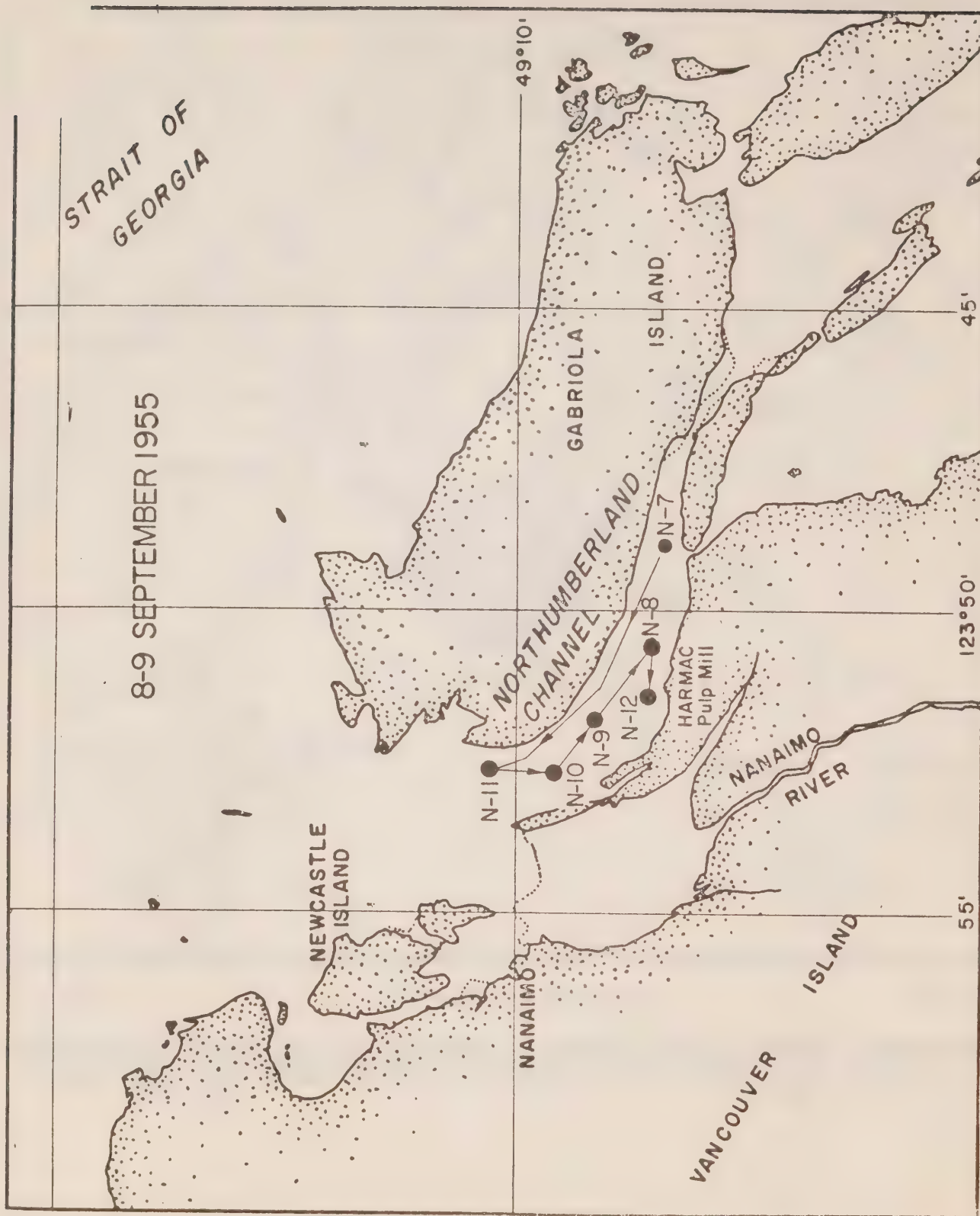


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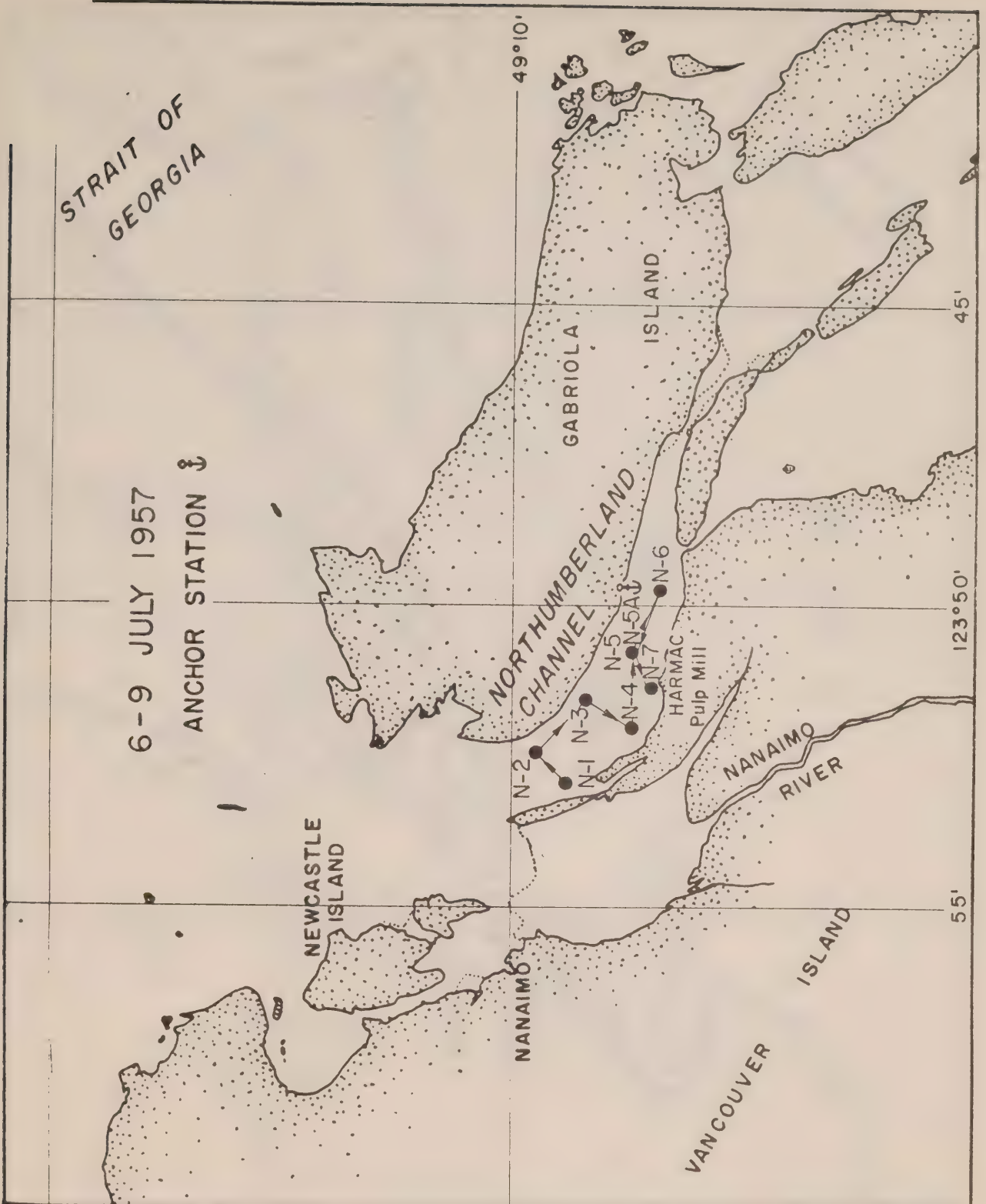


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 Waldichuk, M., J.H.Meikle and J.R.Markert. 1968. Physical and Chemical Oceanographic Data from the East Coast of Vancouver Island, 1954 - 1966. FRB Canada Ms. Rept. 989.

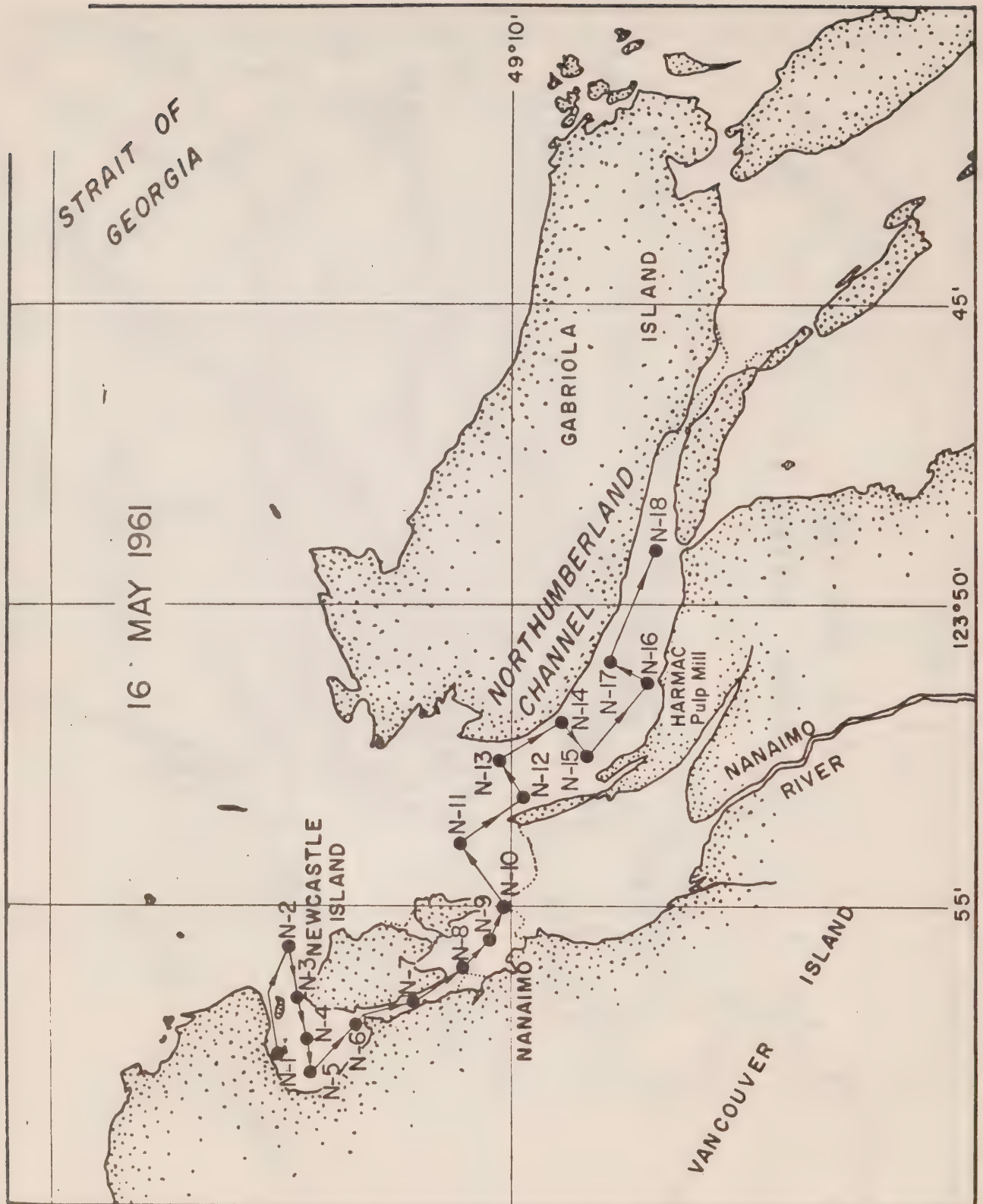


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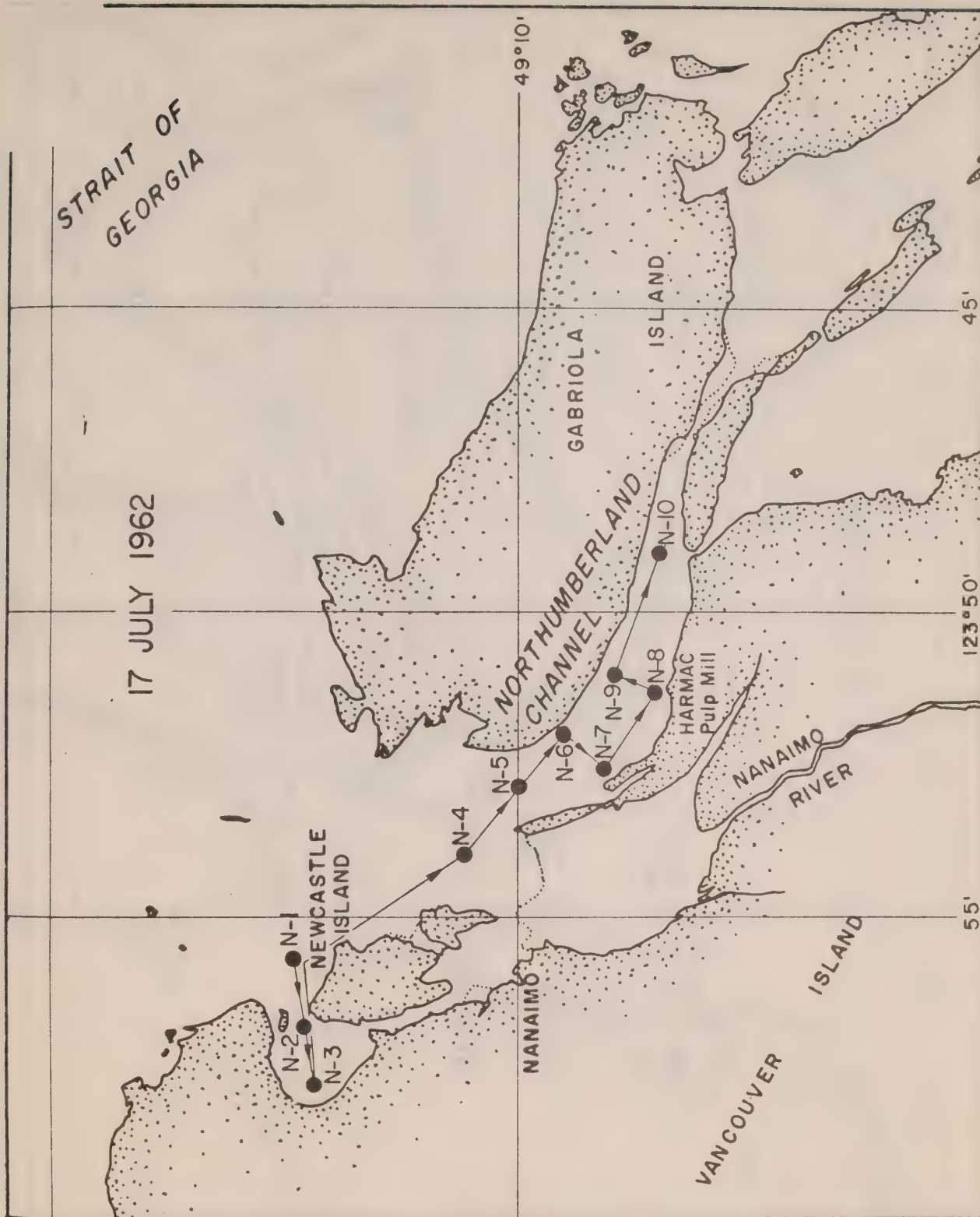


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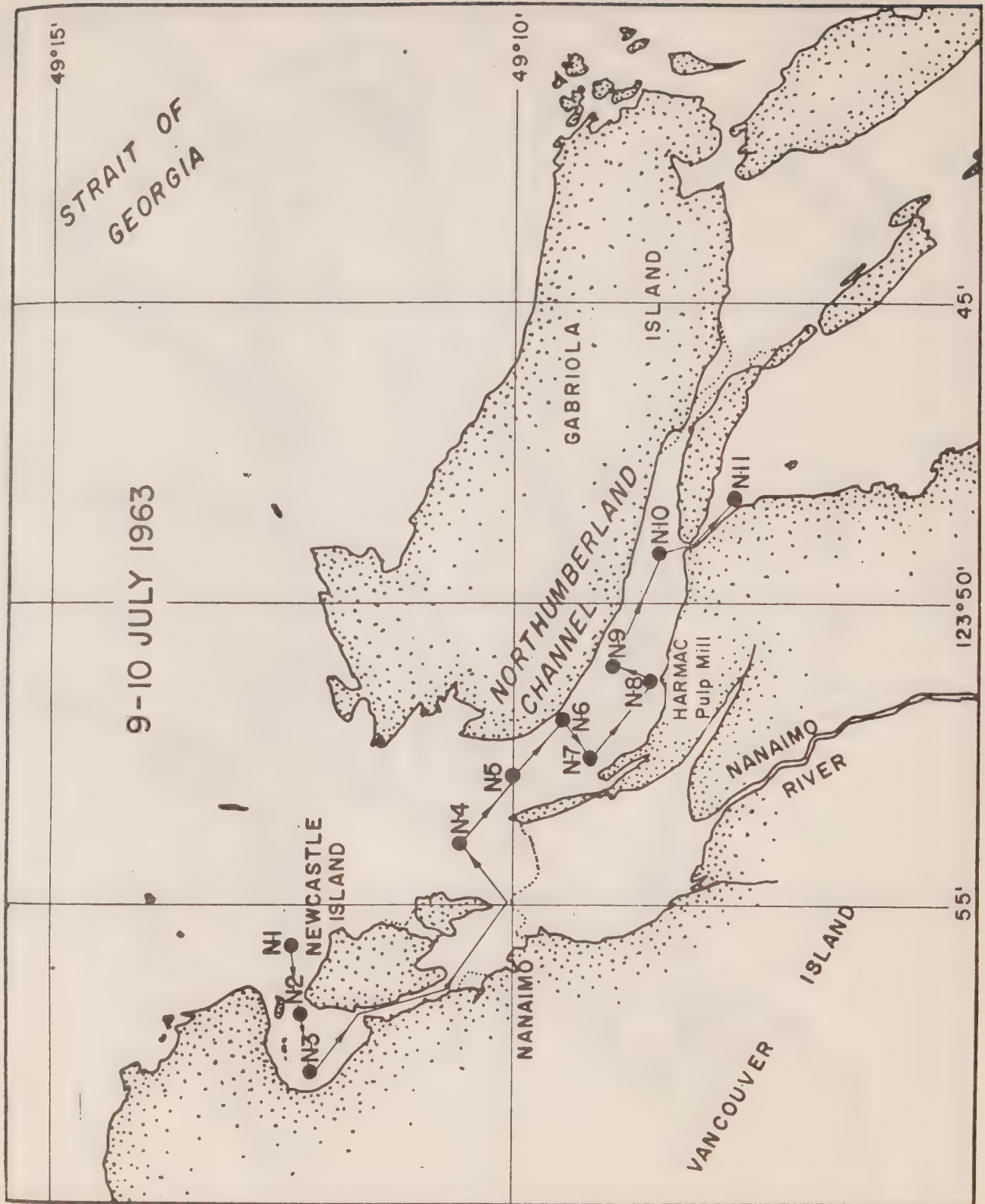


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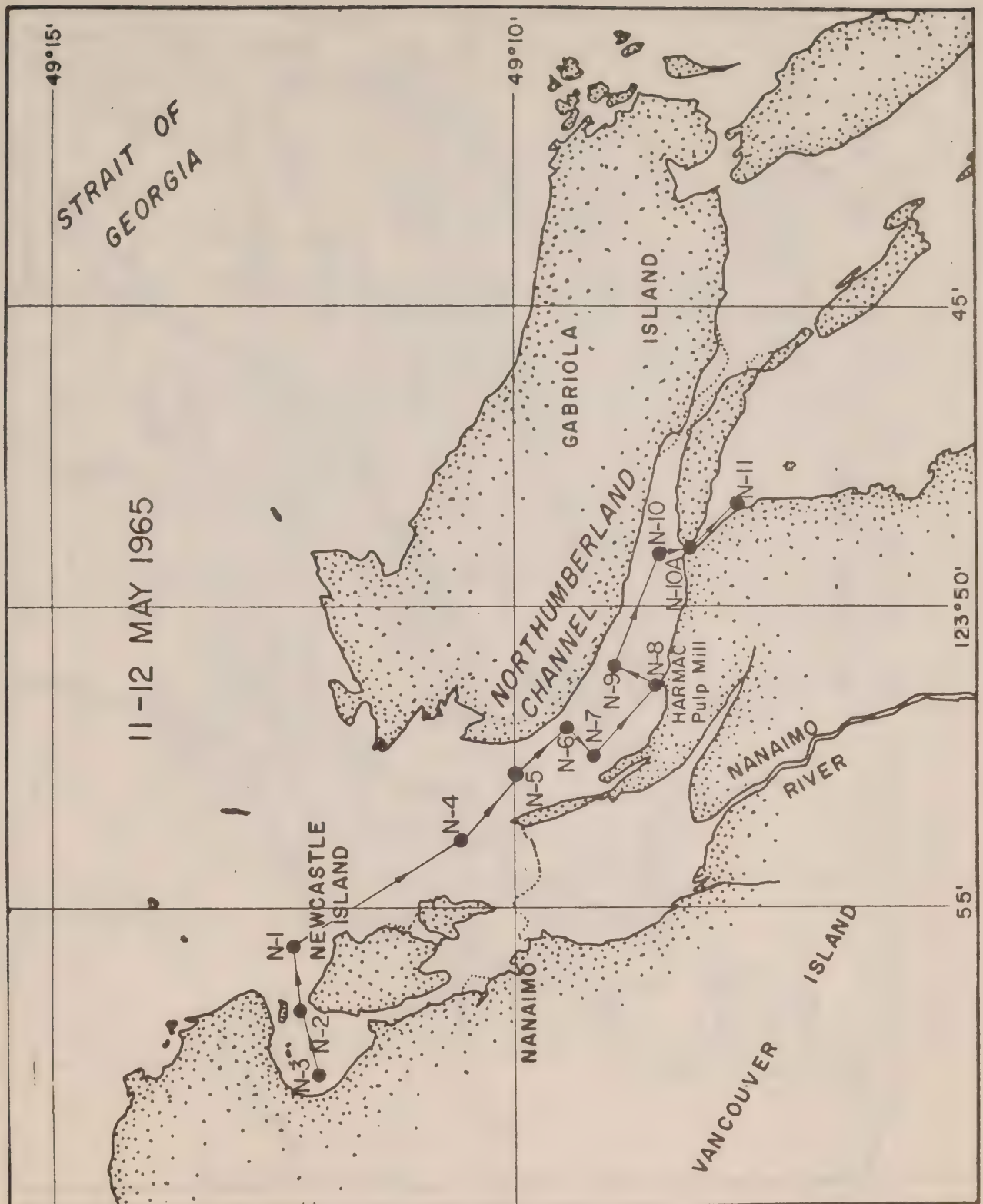


Fig. 32

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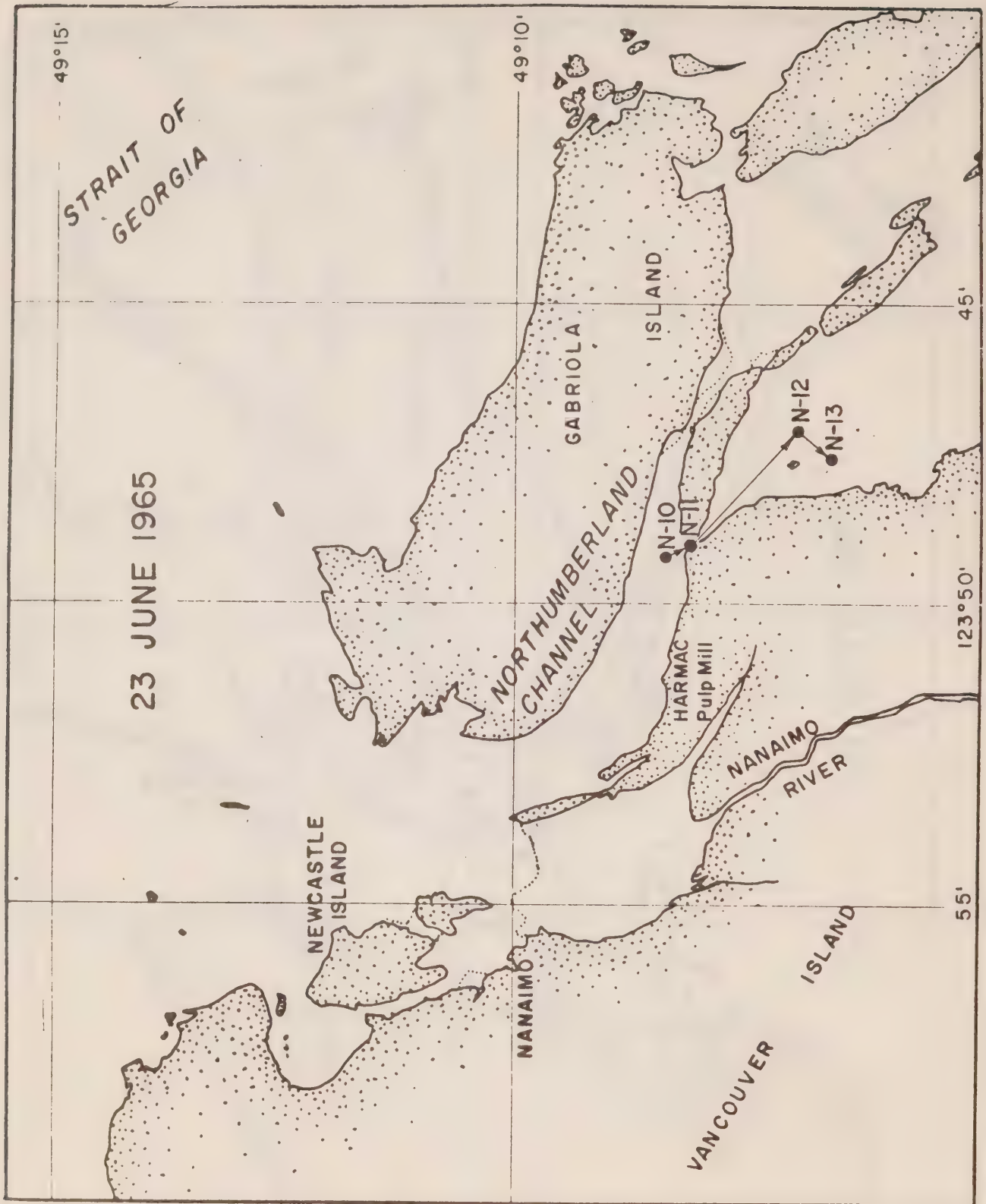


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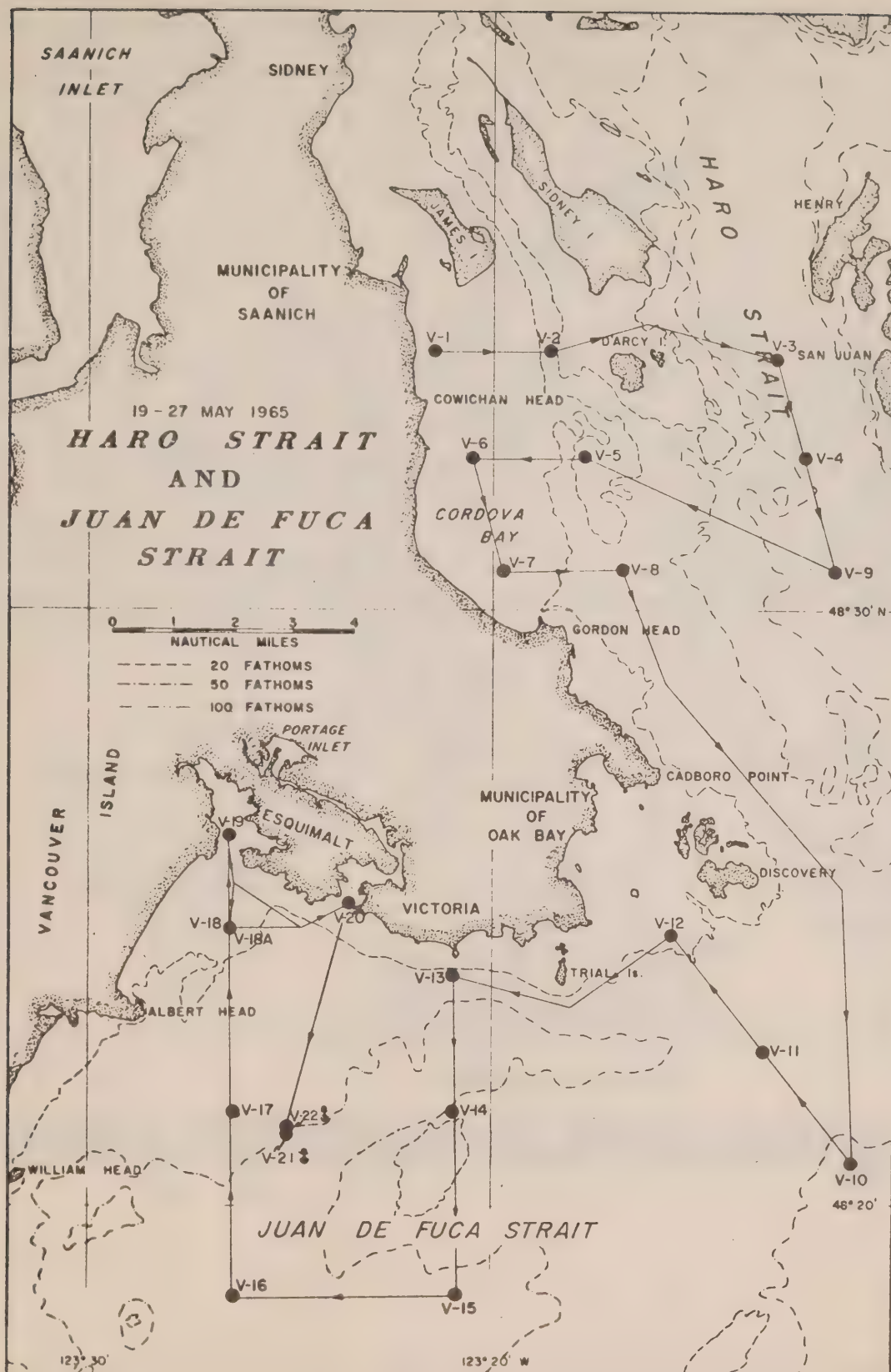


Fig. 34

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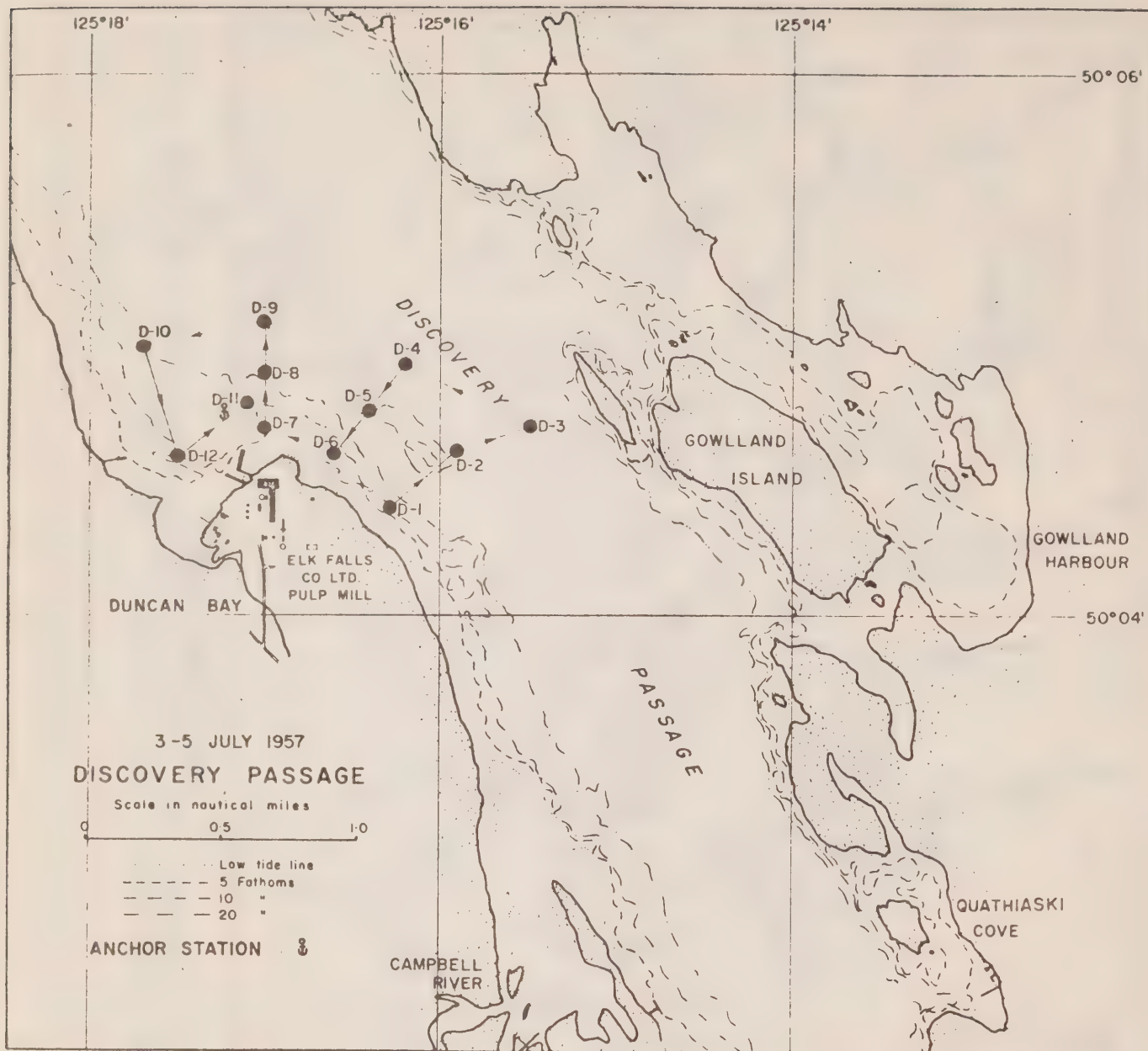


Fig. 35

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Waldichuk, M., J.H. Meikle and J.R. Markert. 1968. Physical and Chemical Oceanographic Data from the East Coast of Vancouver Island, 1954 - 1966. FRB Canada Ms. Rept. 989.

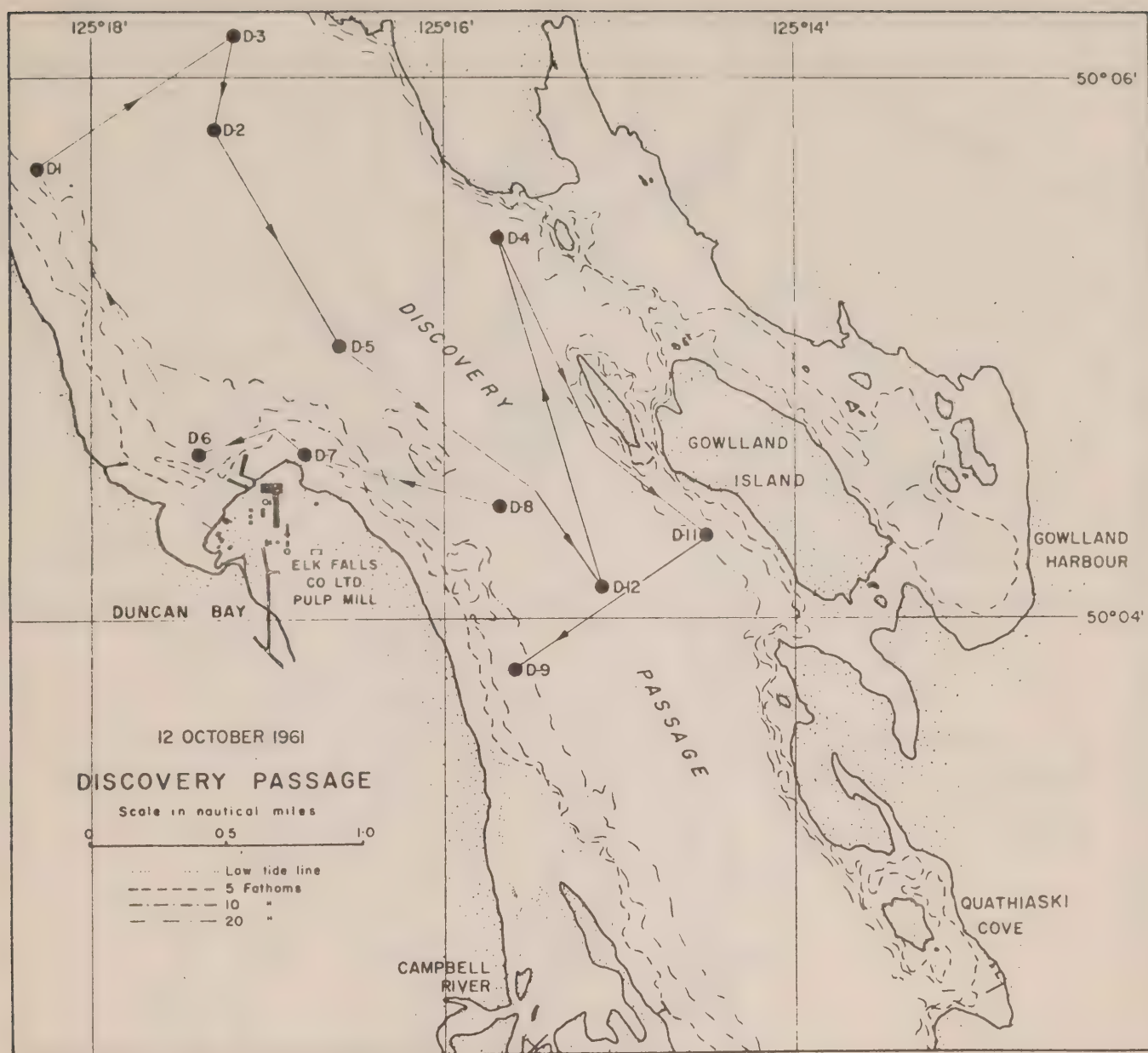


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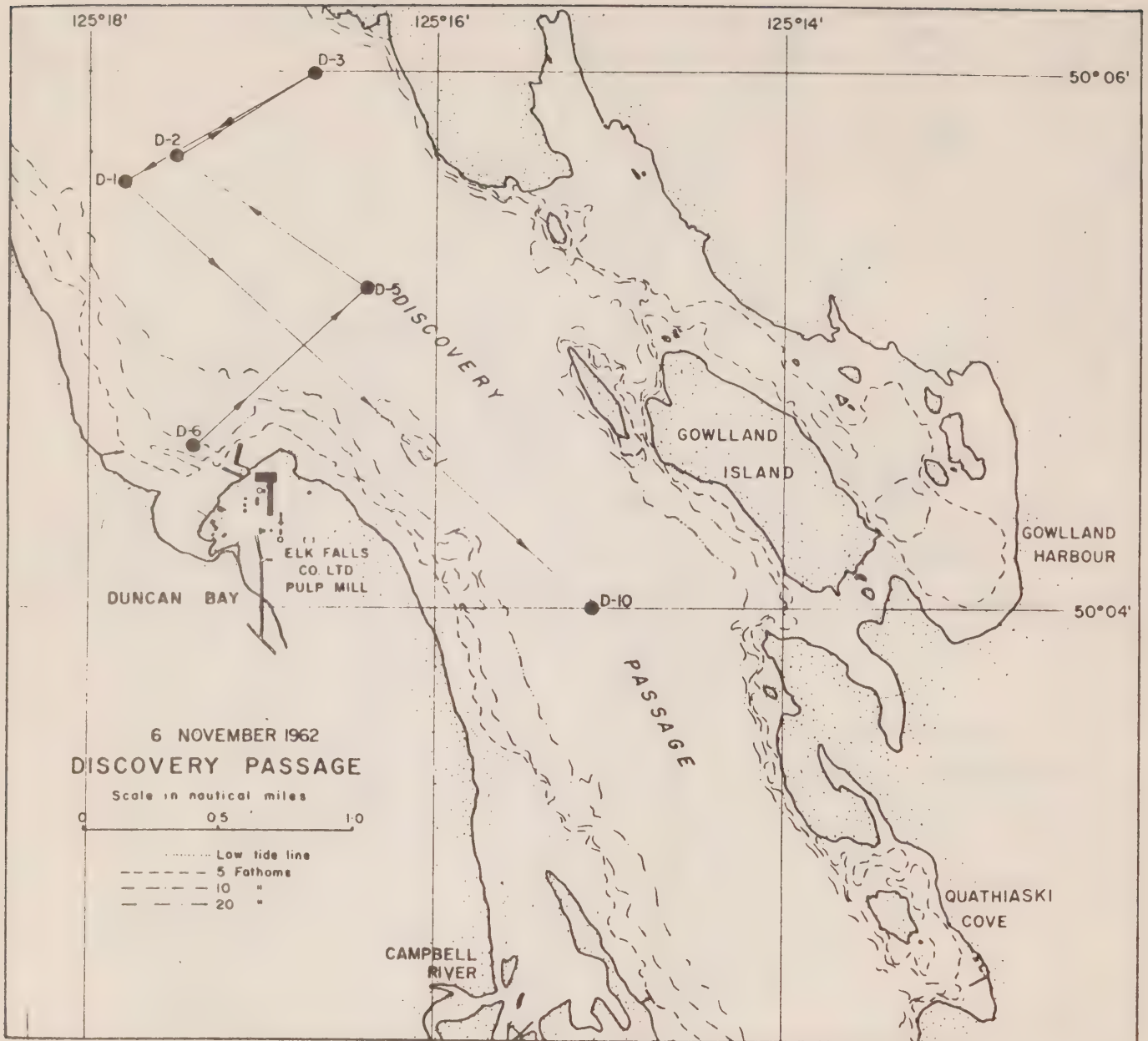


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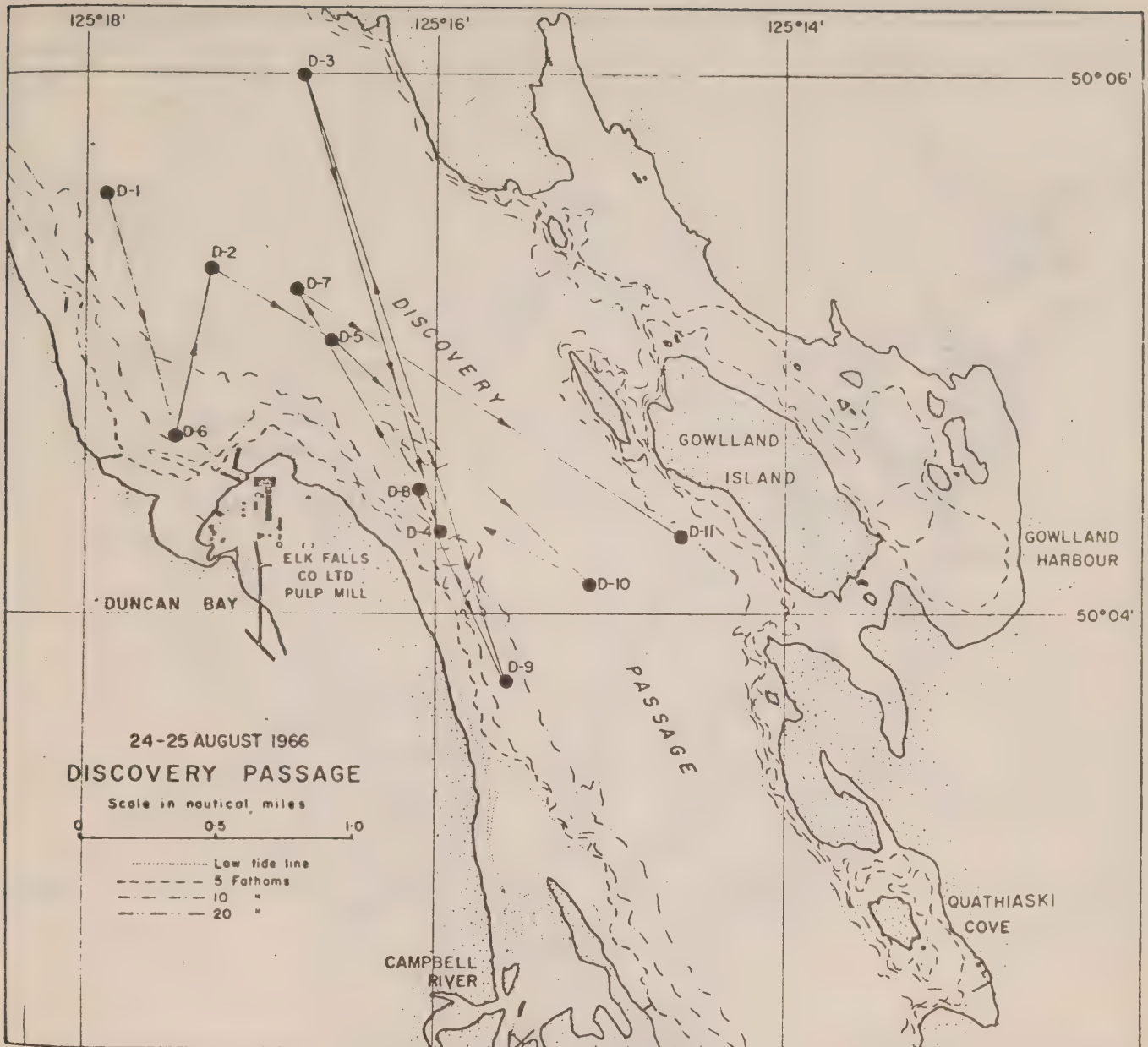


Fig. 38

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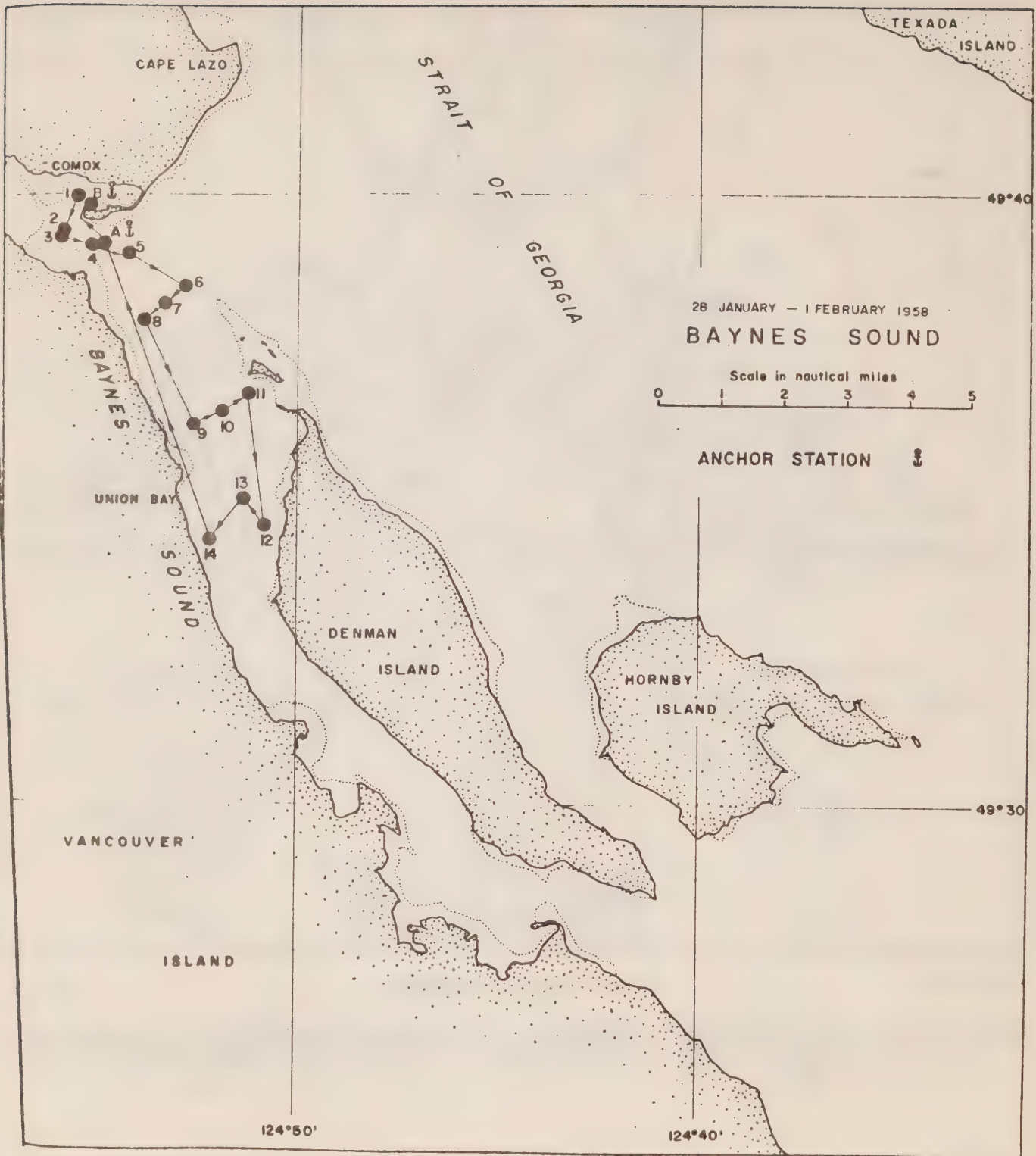


Fig. 39

(January 28 - February 1, 1958)

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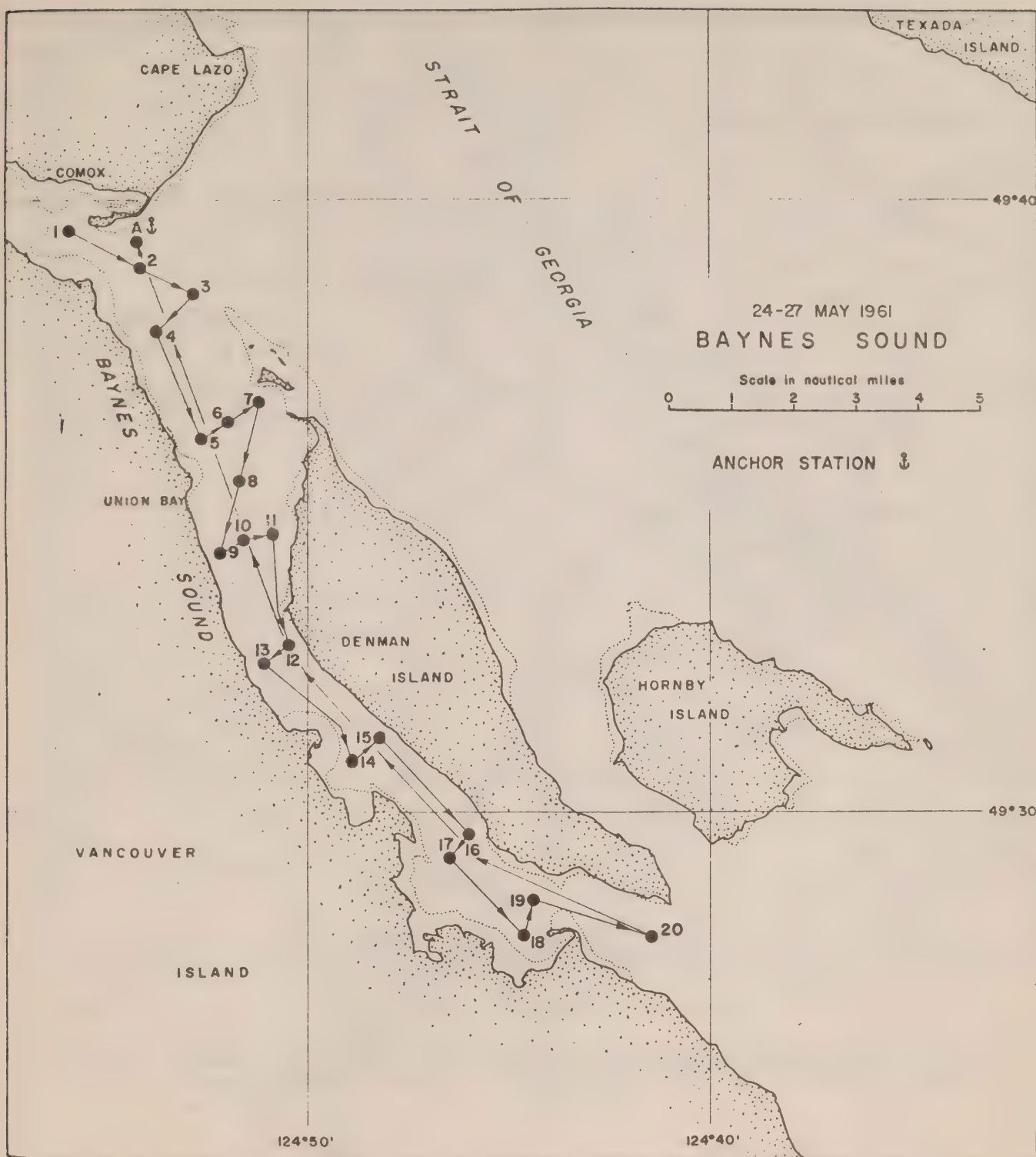


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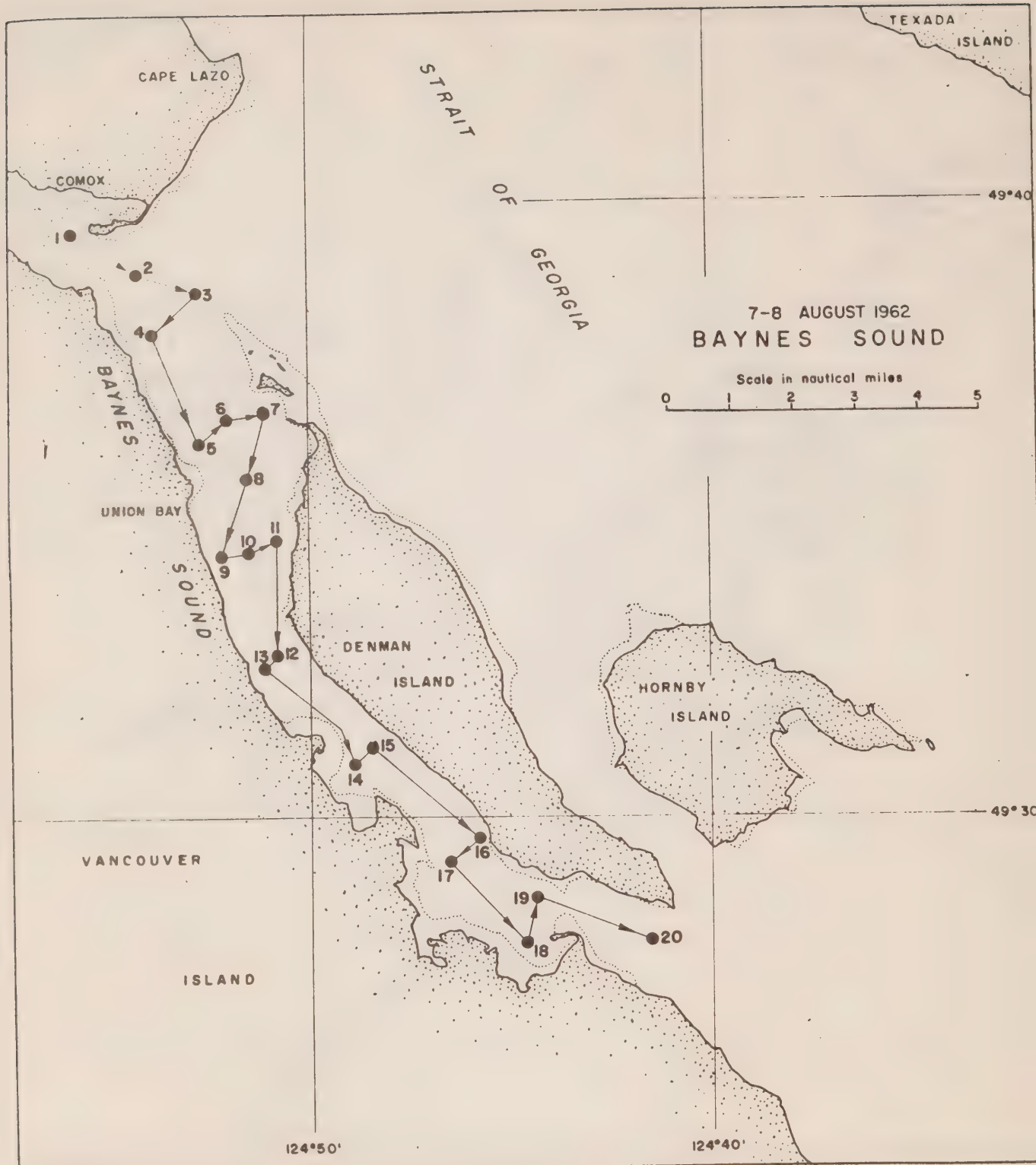


Fig. 41

(August 7 - 8, 1962)

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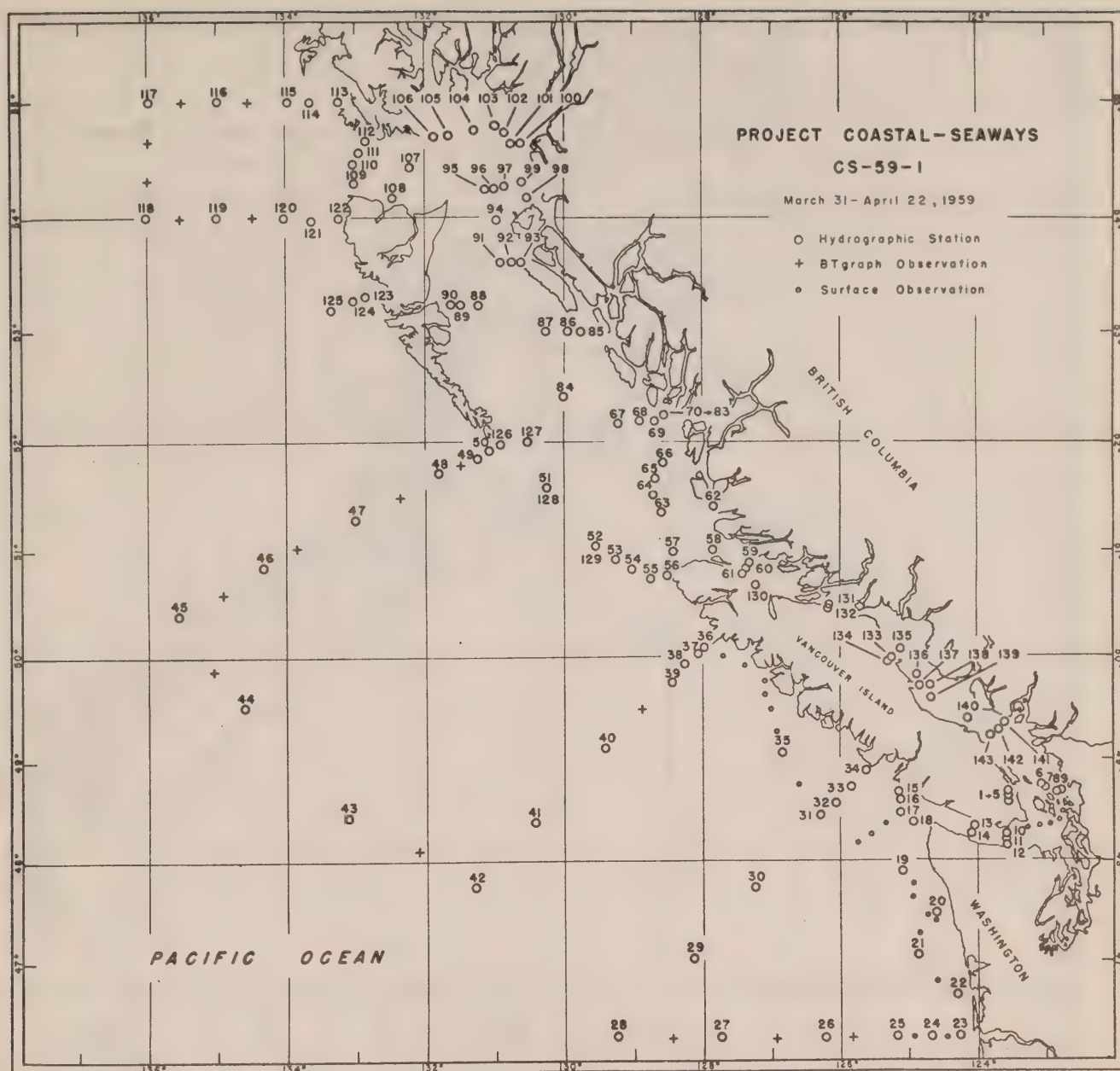


Fig. 42

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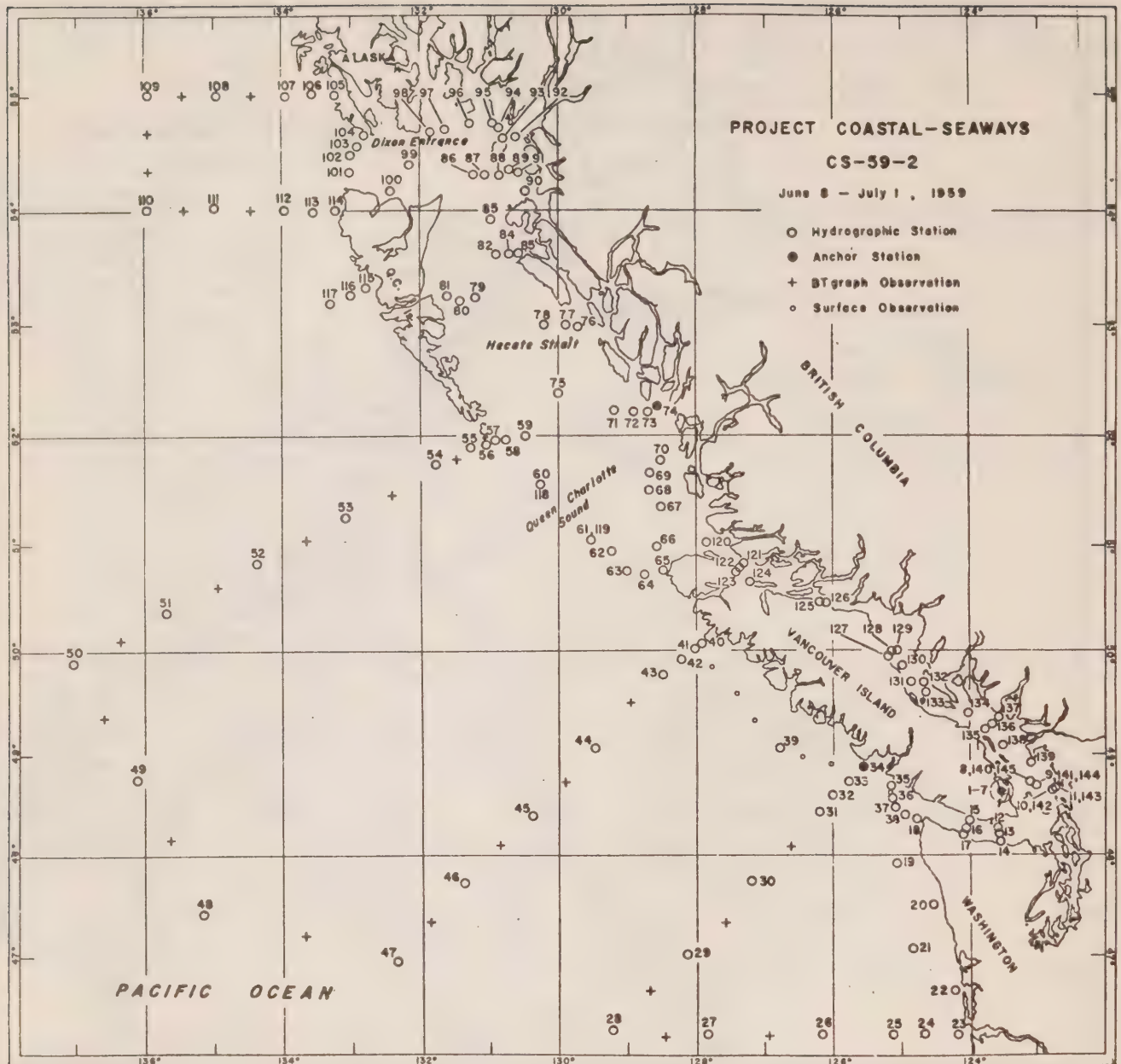


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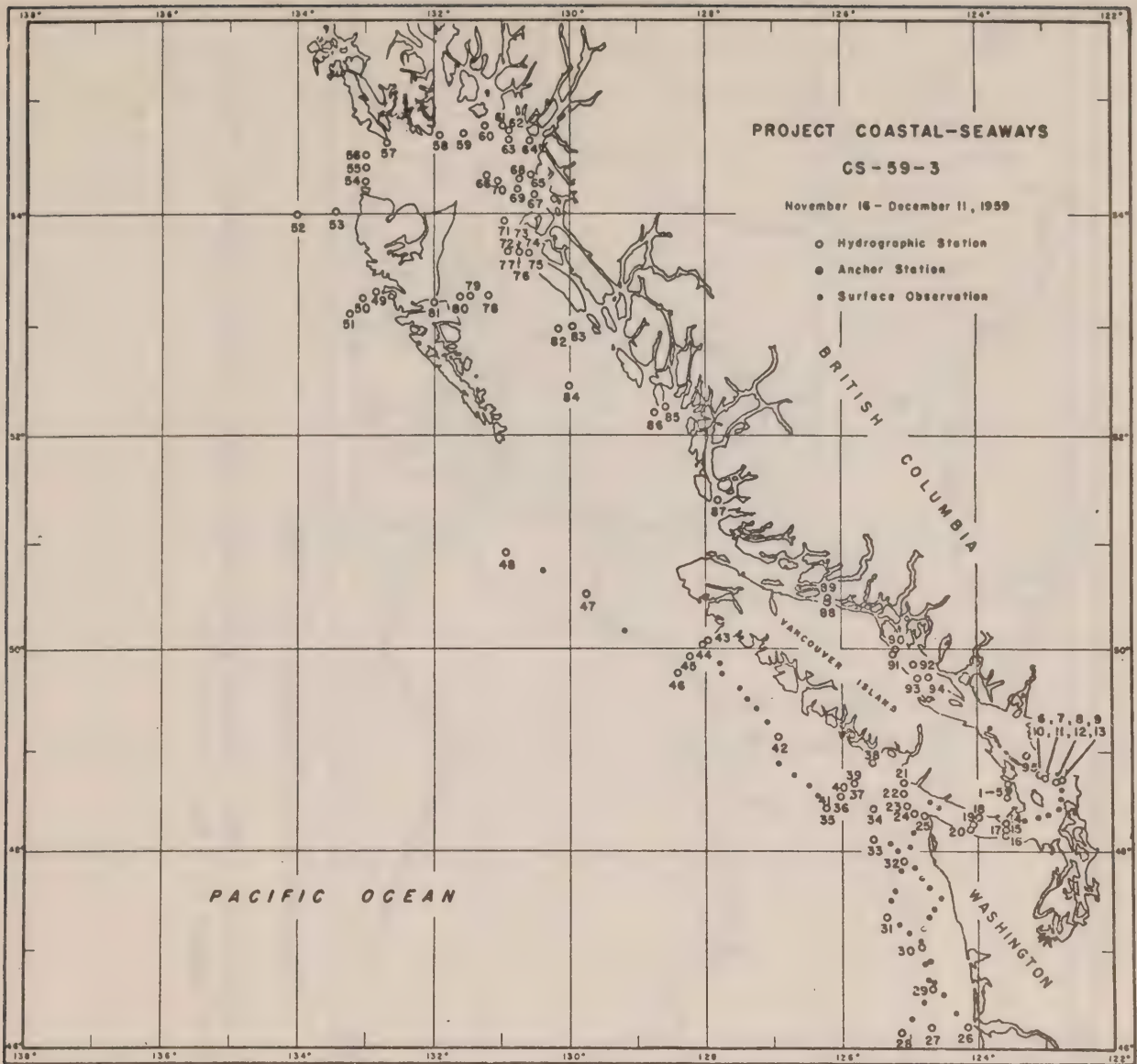


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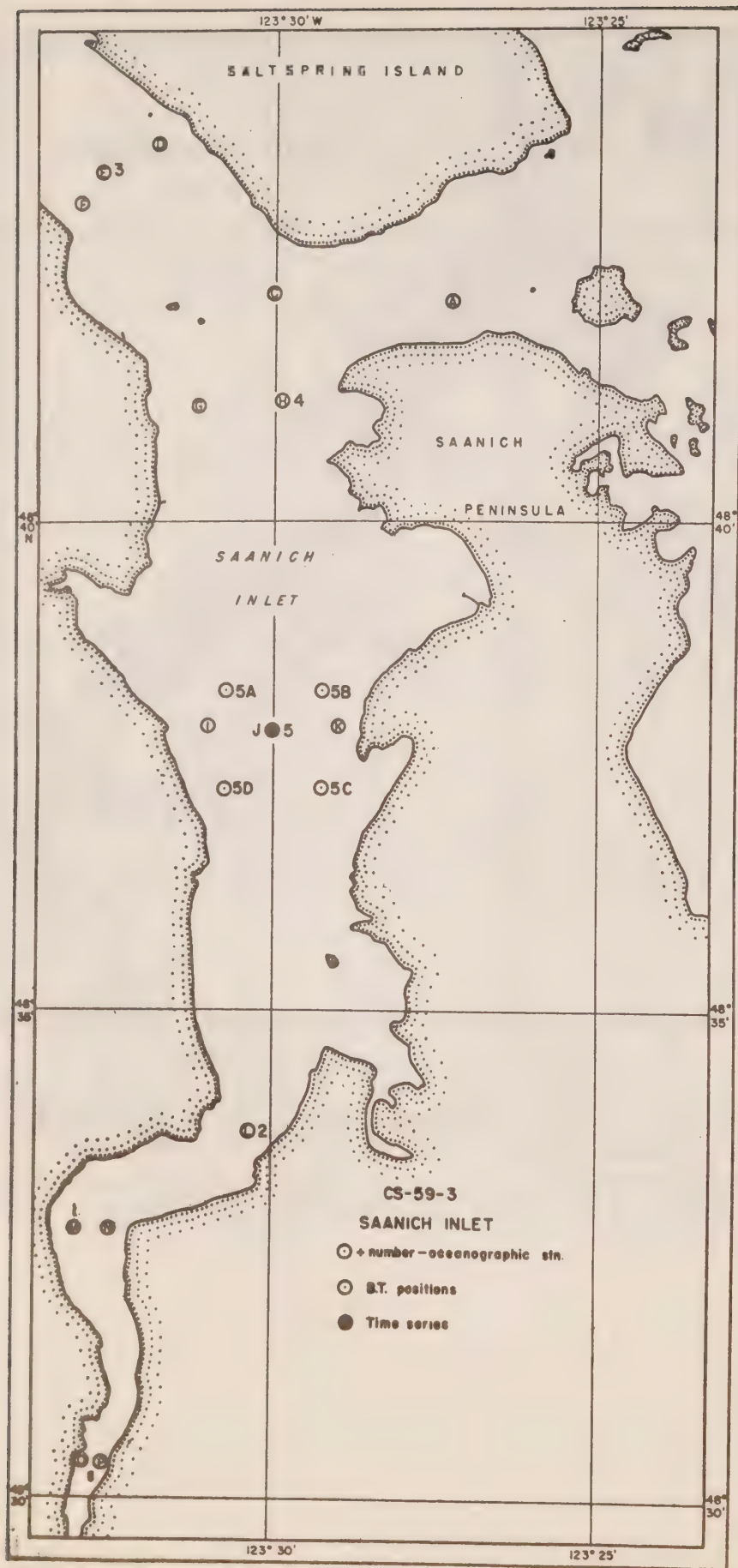


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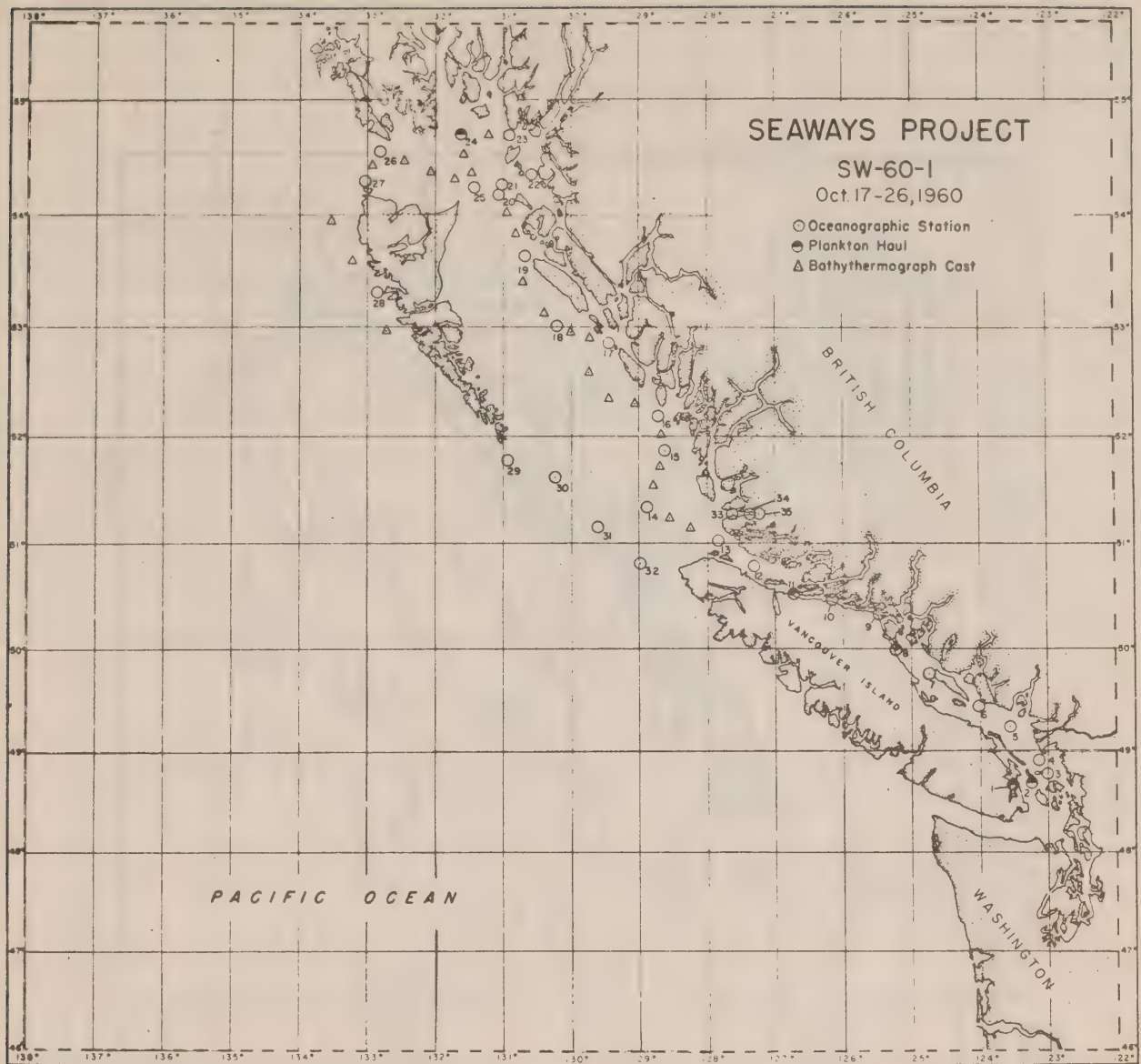


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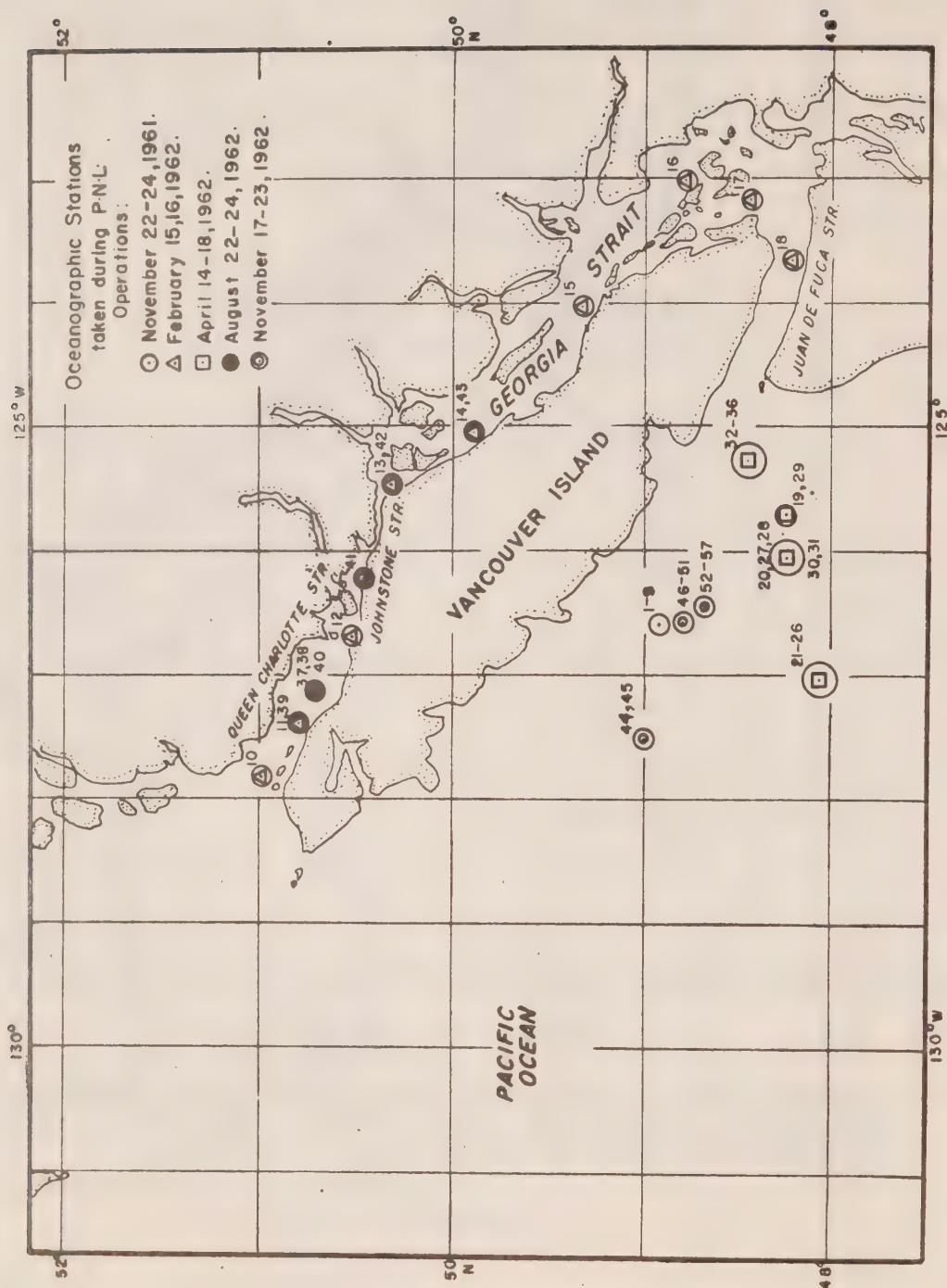


Fig. 47

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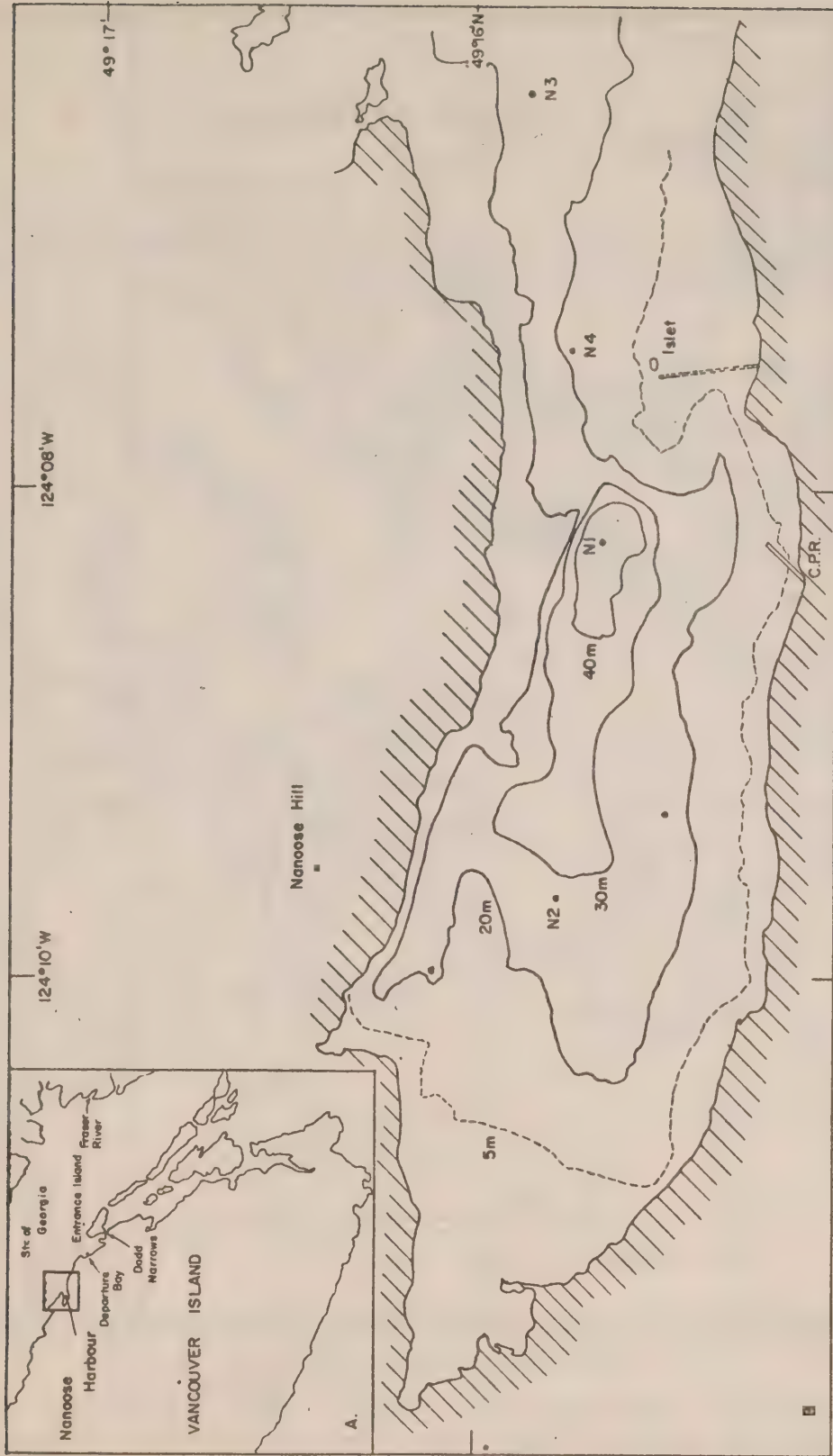


Fig. 48

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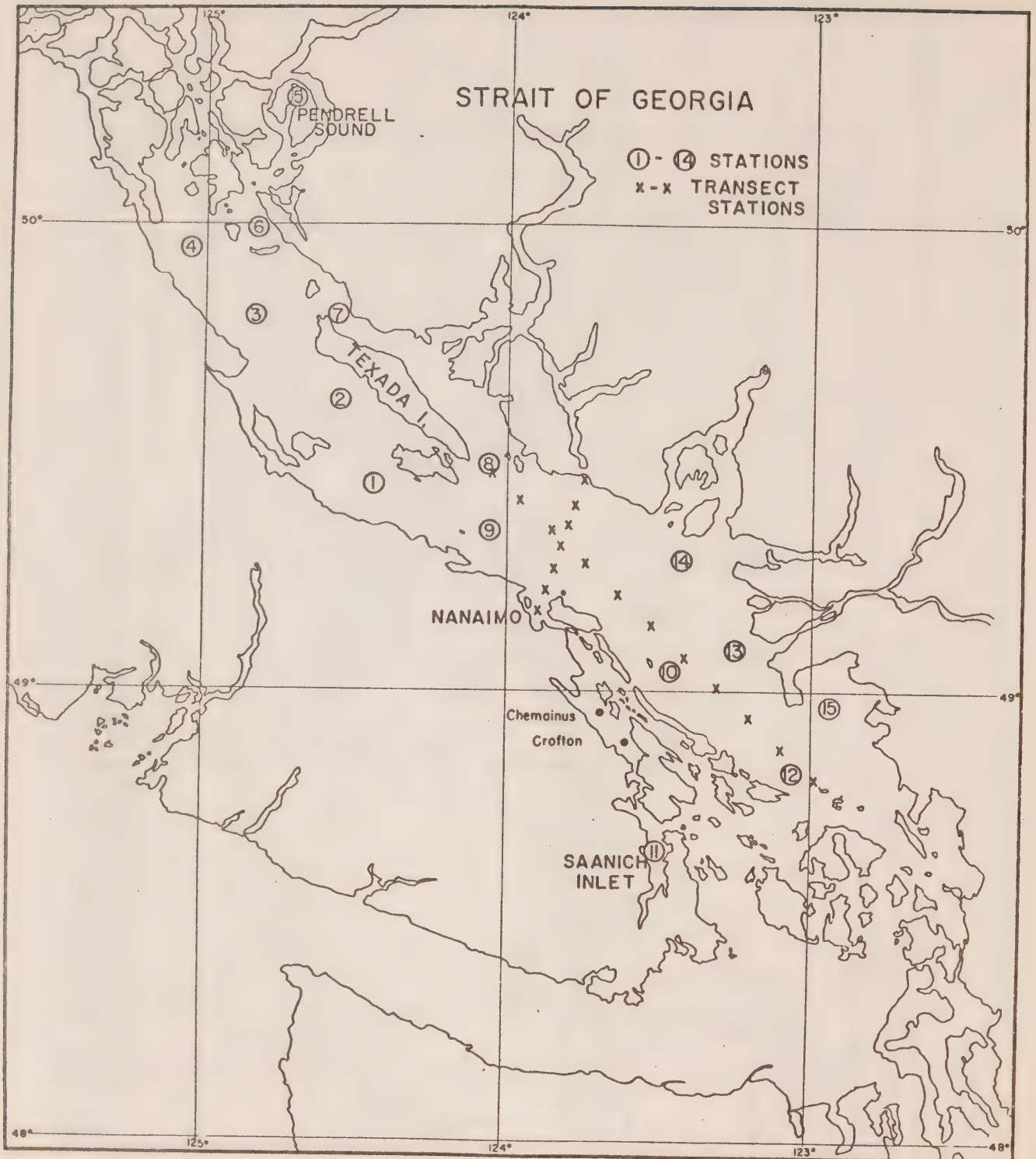


Fig. 49 (March to October, 1965)

S.O.Bishop, J.D.Fulton, O.D.Kennedy and K.Stephens. 1966. Data Record; Physical Chemical and Biological Data, Strait of Georgia, March to October, 1965. FRB Ms. Rept. OL no. 211.



Fig. 50

(August 1965 to December 1966)

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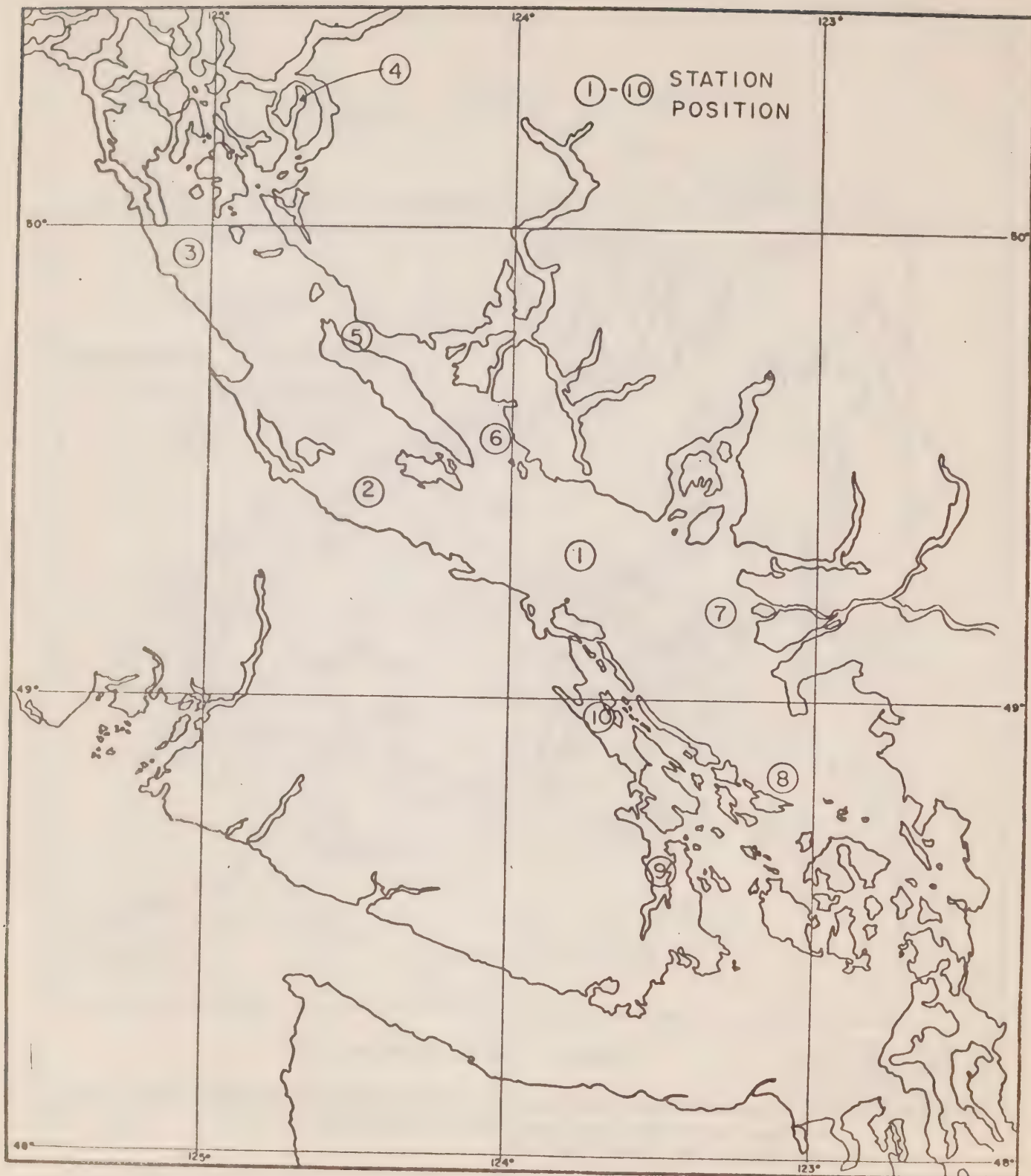


Fig. 51

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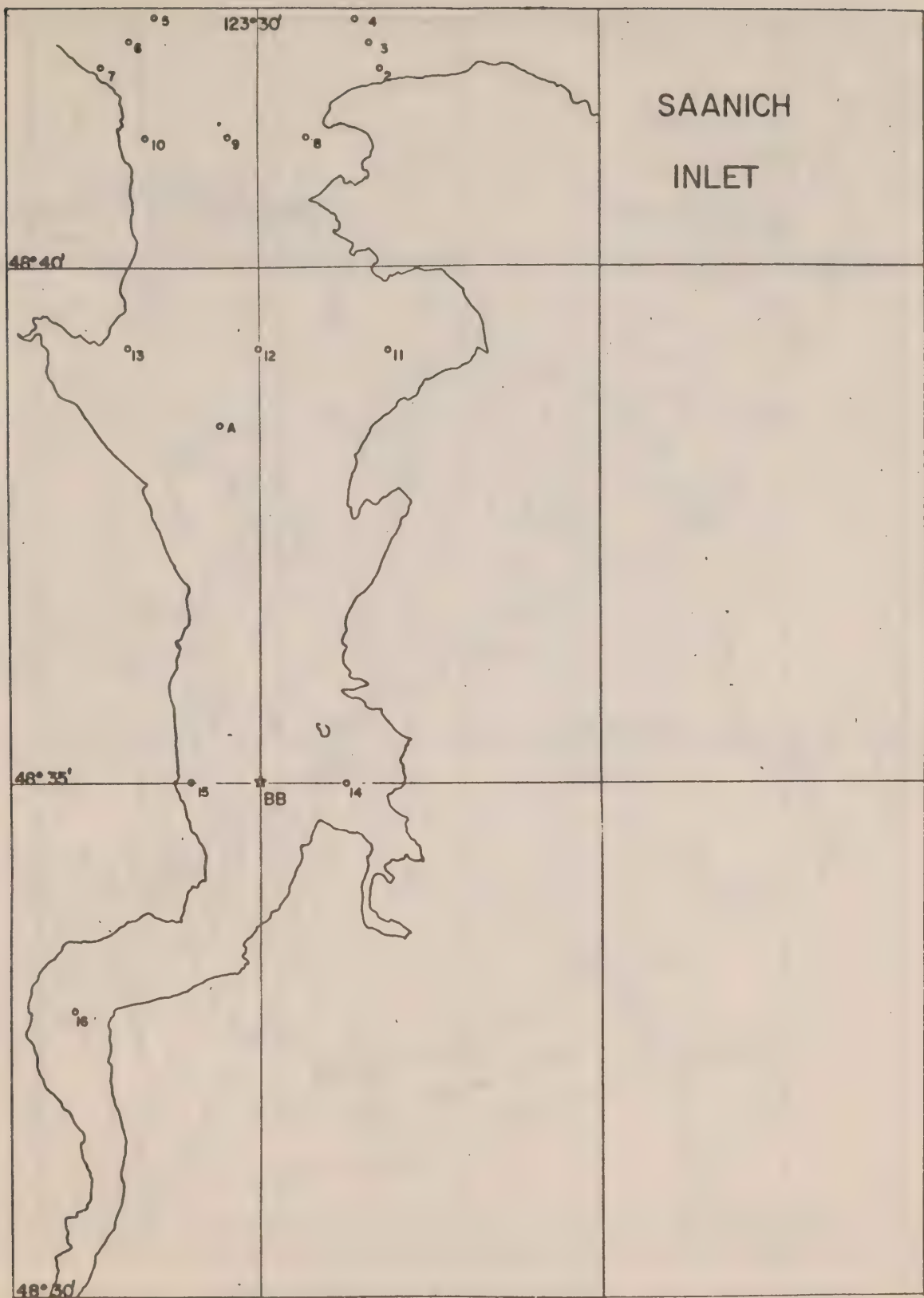


Fig. 52 (June - July, 1966)
 Stephens, K., J.D. Fulton, O.D. Kennedy and A.K. Pease. 1967. Biological, Chemical and Physical Observations in Saanich Inlet, Vancouver Island, B.C. FRB Canada Ms. Rept. 912.

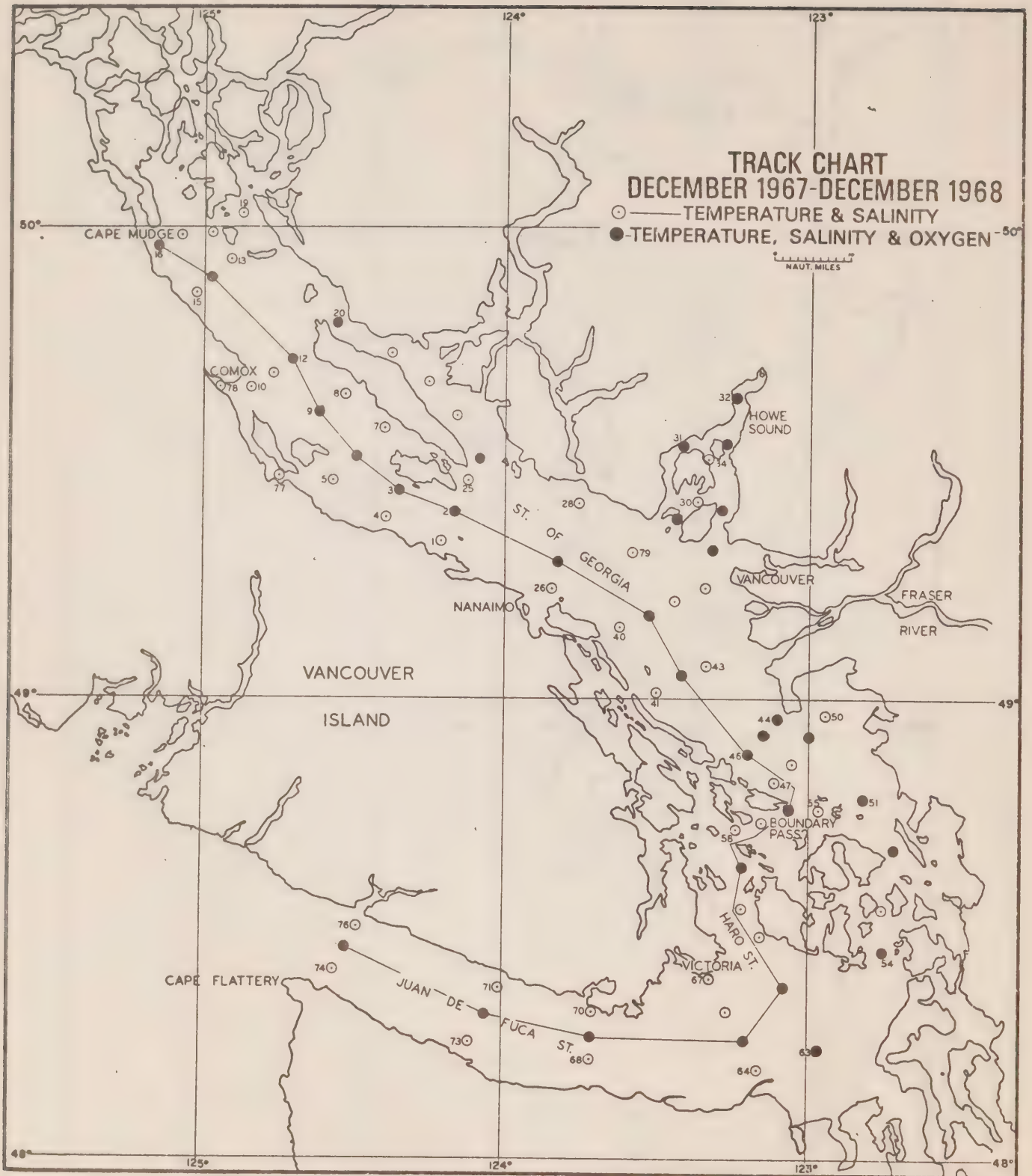


Fig. 53

(December 1967 - December 1968)

Crean, P.B., and A.B. Ages. 1968. Oceanographic Records from Twelve Cruises in the Strait of Georgia and Juan de Fuca Strait. Dept. Energy, Mines and Resources, Marine Sciences Branch, Victoria, B.C.

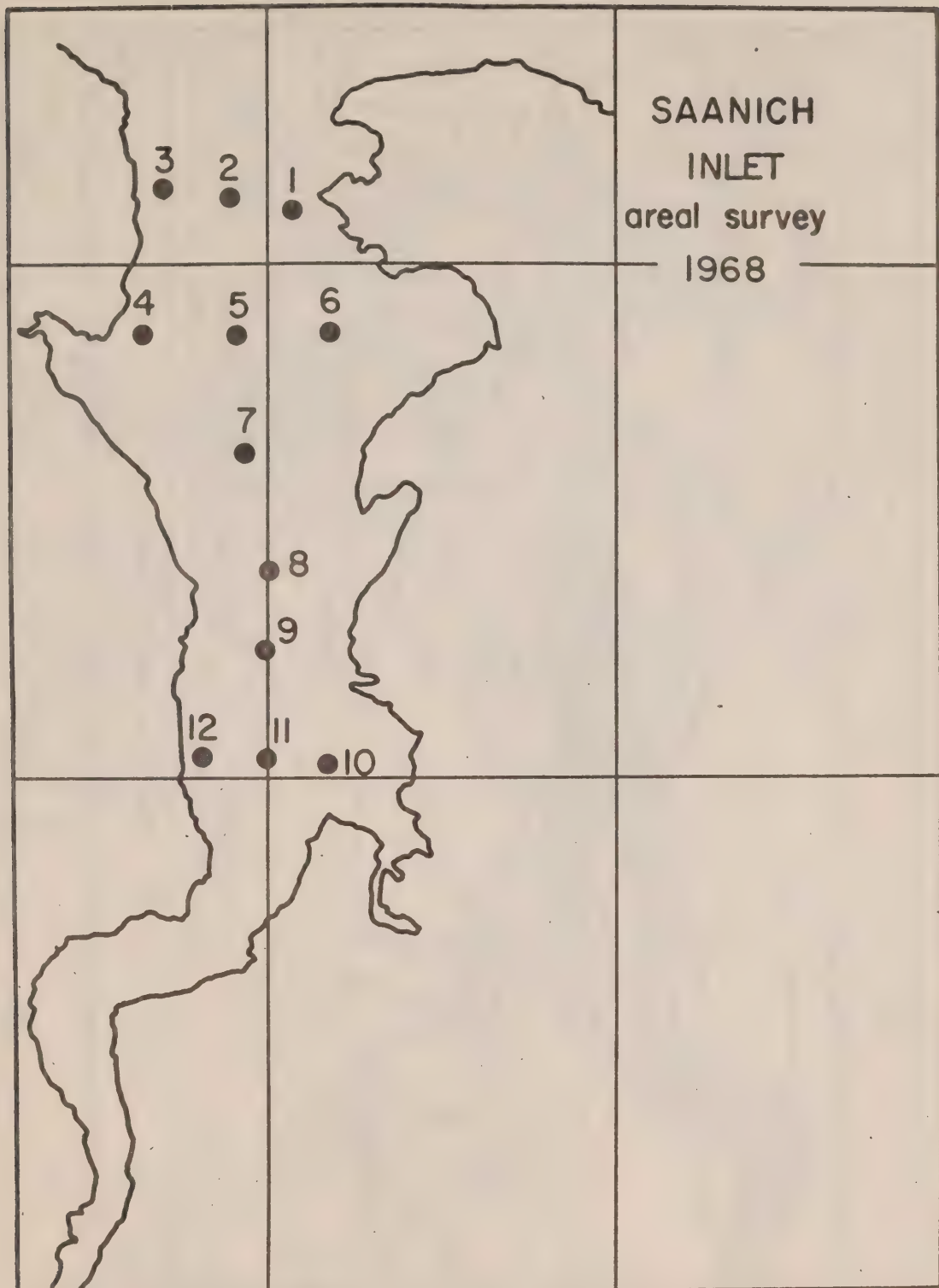


Fig. 54 (May, June, July, 1968)

Fulton, J.D., O.D. Kennedy, H. Seki and K. Stephens. 1969. Biological, Chemical and Physical Observations in Saanich Inlet, Vancouver Island, B.C. FRB Canada Ms. Rept. 1018.

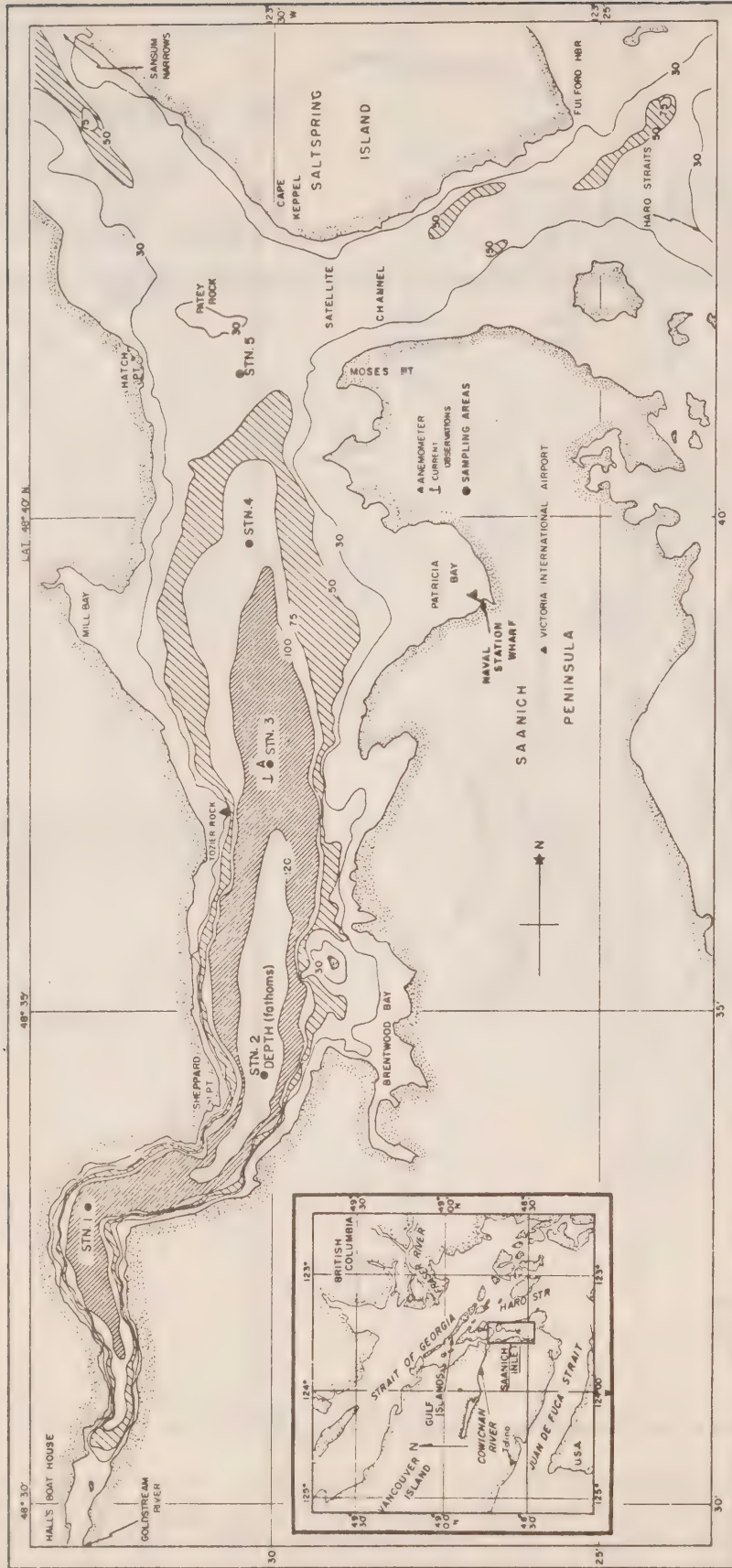


Fig. 55

(May 9 to July 2, 1968)

Herlinveaux, R.H. 1972. Oceanographic Features of Saanich Inlet, 9 May to 2 July, 1968. FRB Canada Tech. Rept. no. 300.

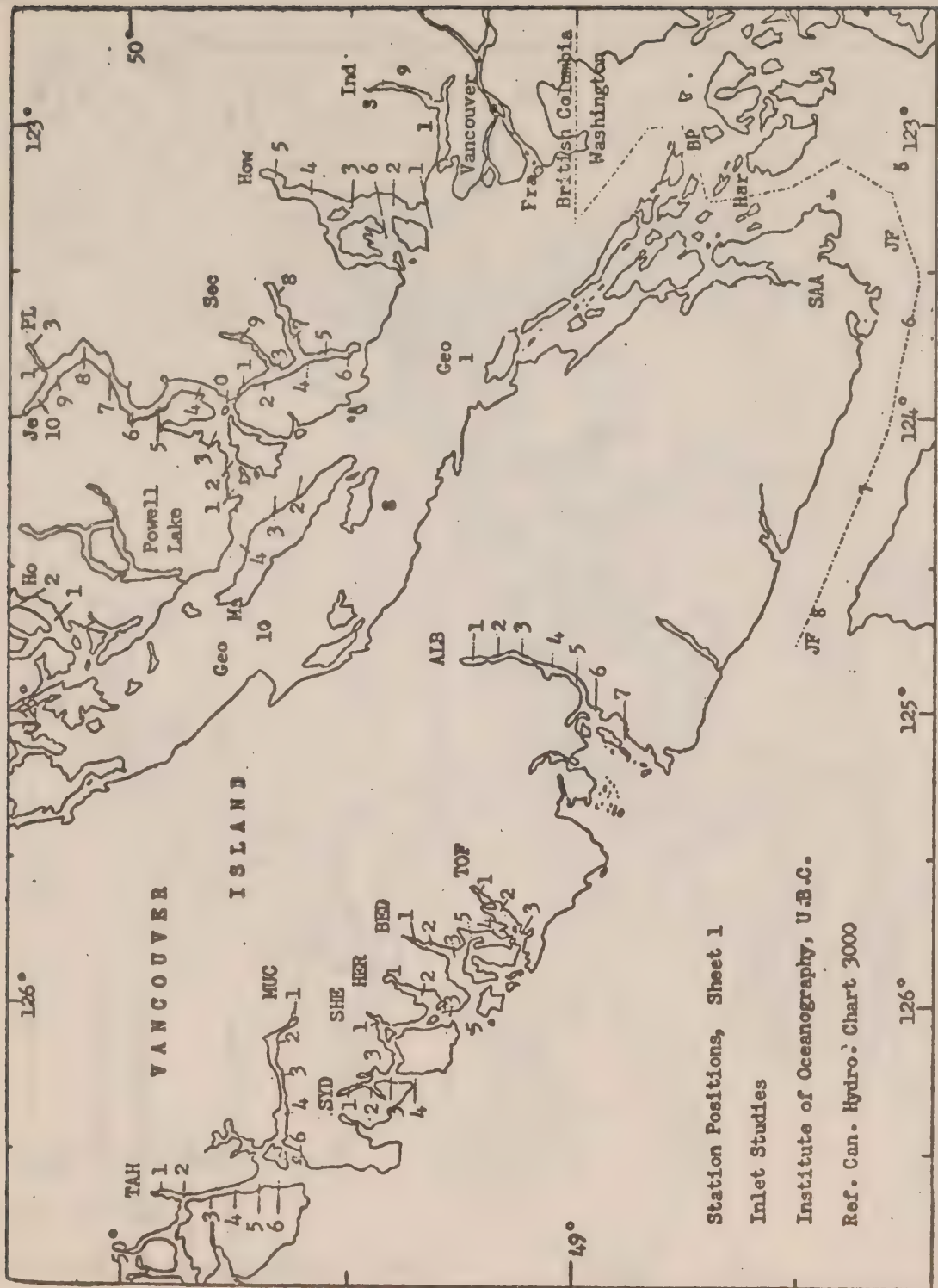


Fig. 56 Typical Track Chart - See Individual Station Records

Institute of Oceanography, University of British Columbia. 1971. Data Report 32, B.C. Inlets and Pacific Cruises, 1970.



Fig. 57

Typical Track Chart - See Individual Station Records

Institute of Oceanography, University of British Columbia. 1971. Data Report 32, B.C. Inlets and Pacific Cruises, 1970.

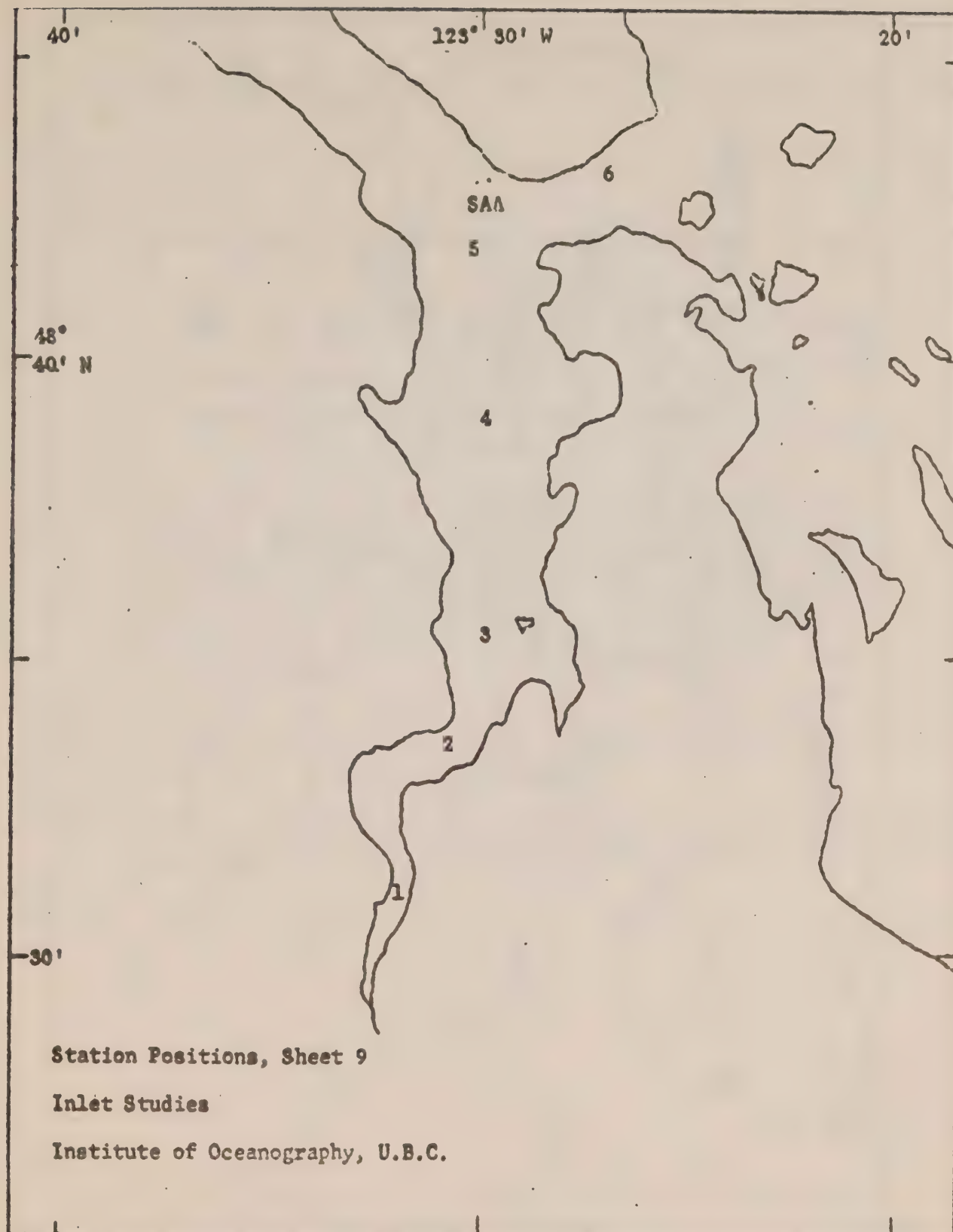


Fig. 58 Typical Track Chart - See Individual Station Records
Institute of Oceanography, University of British Columbia. Data Report 32,
B.C. Inlets and Pacific Cruises, 1970.

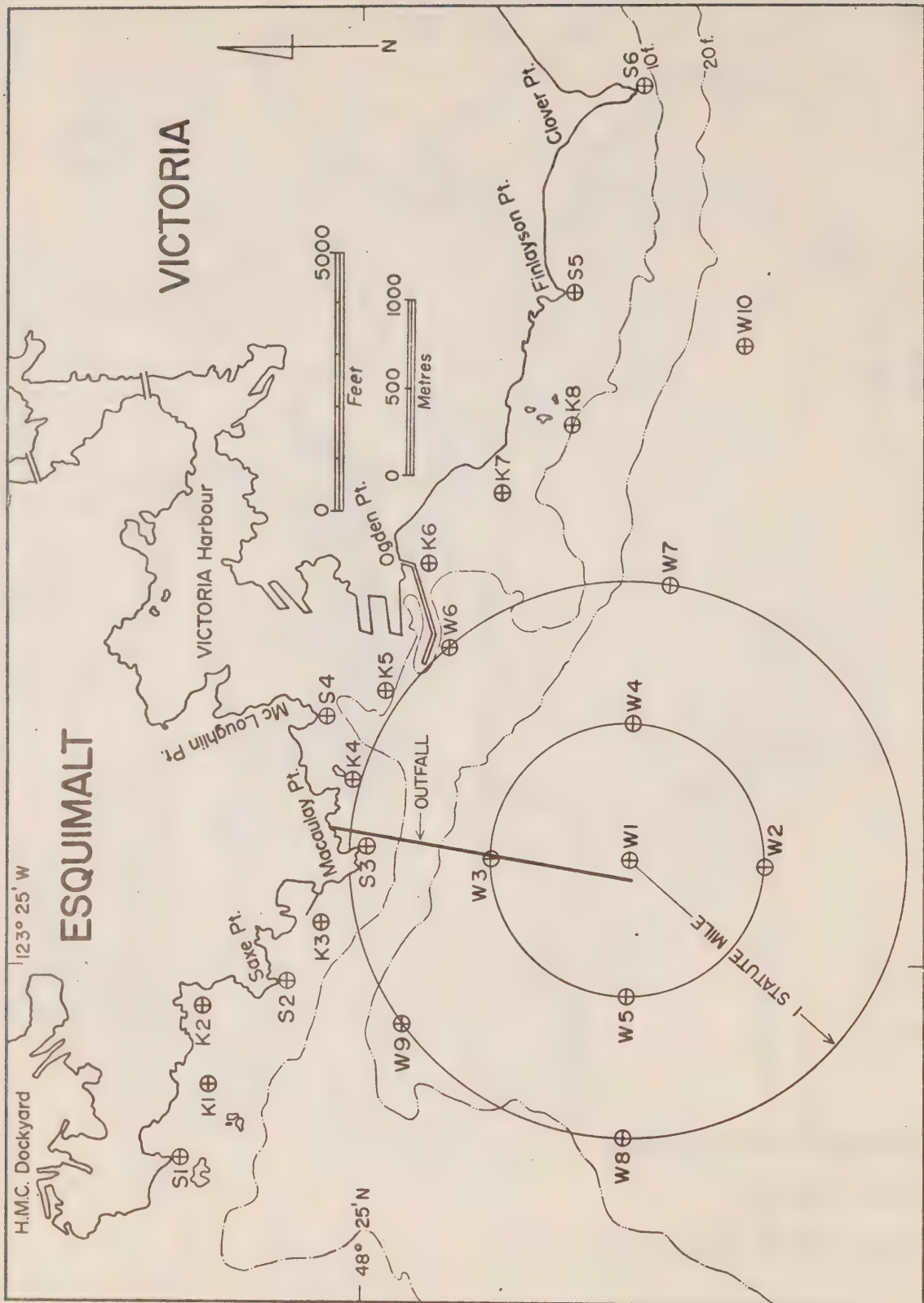
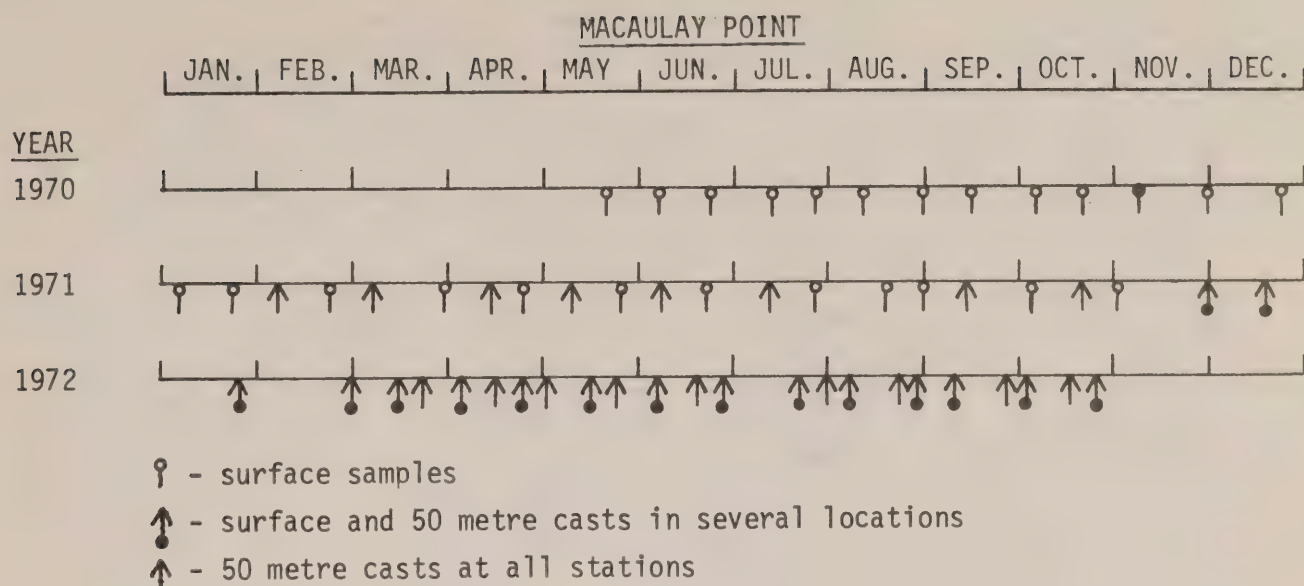


Fig. 59

(May 1970 to October 1972)

Balch, N., E. Marles, D. Ellis, and J. Littlepage. 1972. Macaulay Point Outfall Monitoring Program Annual Report, 1971 - 1972. University of Victoria, Department of Biology, Victoria, B.C.



The Macaulay Point Outfall Monitoring Program was undertaken by members of the University of Victoria Biology Department for the Capital Regional District off the Victoria and Esquimalt waterfront to monitor the effects of an extended domestic sewage outfall. This special interest study obtained a considerable data fund of physical oceanographic information at close intervals extending over a three year period. See figure 59 for a chart of station locations.

Ellis, D.V., J.L. Littlepage and R.W. Drinnan. 1971. The Macaulay Point Outfall Monitoring Program Annual Report, 1970-1971. University of Victoria Department of Biology, Victoria, B.C.

Balch, N., E. Marles, D.V. Ellis and J.L. Littlepage. 1972. Macaulay Point Outfall Monitoring Program Annual Report, 1971-1972. University of Victoria, Department of Biology, Victoria, B.C.

Fig. 60

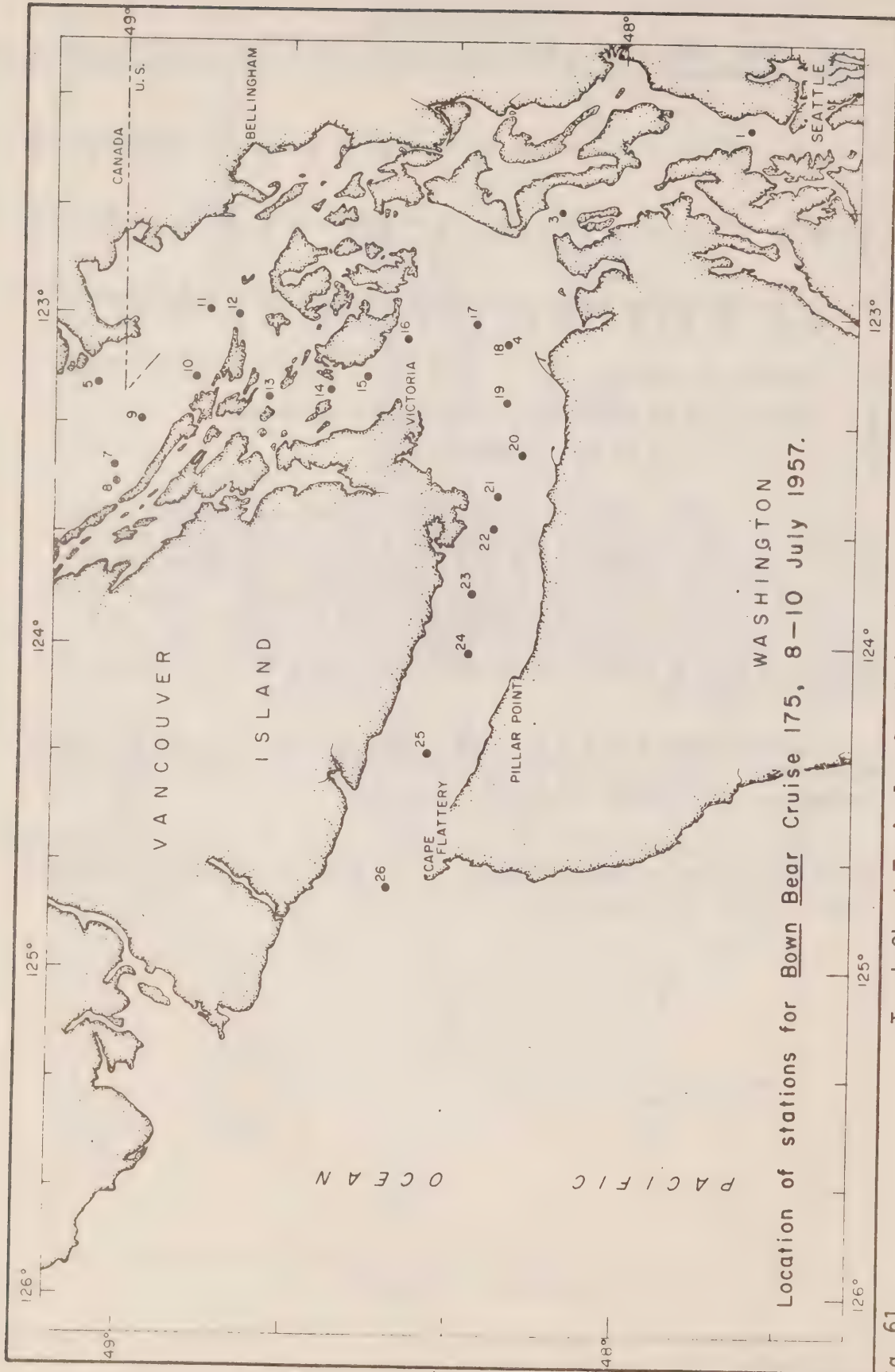


Fig. 61

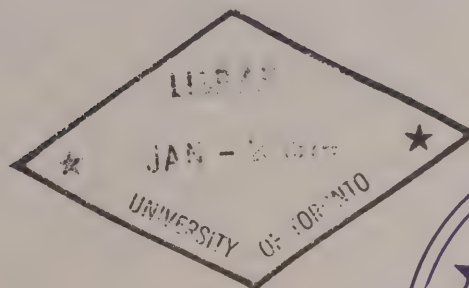
Track Chart Typical - See Individual Station Records

Collias, E.E., and C.A. Barnes. 1964. Physical and Chemical Data for Puget Sound and Approaches, Sept. 1956 to Dec. 1957. University of Washington, Department of Oceanography Tech. Rept. 110.

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**Bibliography of Oceanographic Information for
the Inside Waters of the
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Volume 2 - Biological Oceanography**

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BIBLIOGRAPHY OF OCEANOGRAPHIC INFORMATION FOR THE
INSIDE WATERS OF THE SOUTHERN BRITISH COLUMBIA COAST

VOLUME II - BIOLOGICAL OCEANOGRAPHY

by

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Marine Sciences Directorate, Pacific Region

Environment Canada

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INTRODUCTION

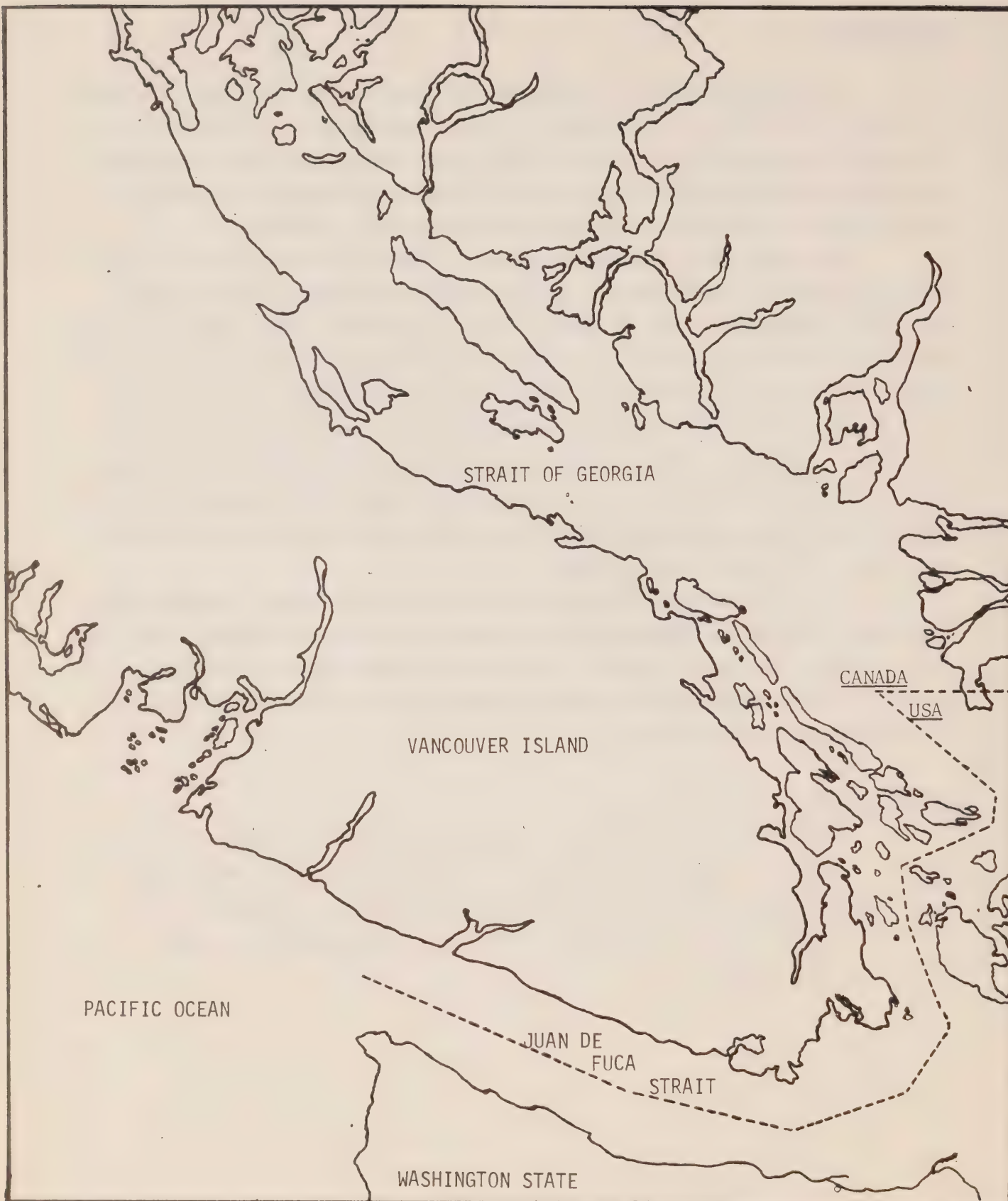
This bibliography of biological oceanography in the Strait of Georgia - Juan de Fuca system was produced as a companion volume to a bibliography of physical oceanography for the same region. This study is primarily concerned with environmental biology since the two volumes were designed to increase accessibility of information for environment-oriented studies.

The biological literature for this region is extensive and diffuse. Searching the many international journals where publications could appear would be a monumental task. In this case the problem has been reduced by making heavy use of the publication lists of those agencies concerned with marine biology in the area. Publications originating with government agencies and those universities with collected publication lists are therefore probably effectively recorded. Another difficulty arises from this method in determining the geographical area from the title of the paper. This approach has obviously omitted many citations but has provided a good starting point in the literature for future investigation.

The bibliography has been divided into two sections, one concerned with marine biology in general and the other with fisheries biology. The fisheries section, indicated by an "F" following the page number of an indexed citation, includes papers about tagging, catch statistics and related topics of fisheries management interest.

ACKNOWLEDGEMENTS

Appreciation is due to Dr. J.F.Garrett for his review of the manuscript and also to those learned souls who have recognized the importance of maintaining publication lists in their particular field of endeavour. The patience and care of Ms. A.Hartley in typing the bibliography and index is gratefully acknowledged.



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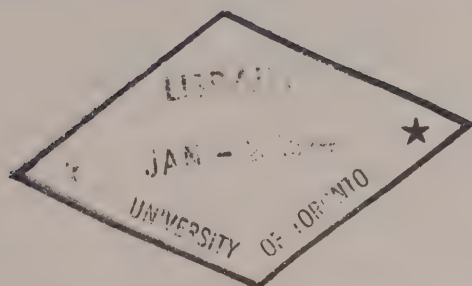
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A NUMERICAL MODEL OF VICTORIA HARBOUR TO PREDICT TIDAL RESPONSE TO PROPOSED HYDRAULIC STRUCTURES

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INTRODUCTION

Victoria Harbour is situated on the north shore of the Strait of Juan de Fuca, 60 miles eastward of its ocean entrance. The harbour is part of a tidal estuary, extending through Gorge Waters to Portage Inlet over a distance of five miles (fig. 1). The estuary is about 50 feet deep at its entrance and shallows to a depth of less than ten feet in the Gorge and Portage Inlet.

The flow characteristics are predominantly tidal. The fresh-water runoff into the system is supplied by two creeks but is negligible.

The outer harbour accommodates large ocean-going vessels loading grain and lumber; the inner and upper harbours are used by ferries and coasters. The Gorge Waters and Portage Inlet are accessible only to small craft and have no significance as a navigable waterway. However, located in the heart of a growing urban area with a population of close to 200,000, this relatively large body of water has become an invaluable recreational asset and a unique tourist attraction (tourism accounts for about one-half of Victoria's income).

Unfortunately, the estuary has been a receiving water for industrial and domestic wastes and although much has been done to introduce better disposal methods, the Gorge and Portage Inlet are still so badly polluted that their beaches have remained closed for quite some time. Marine life in the estuary has been surprisingly resilient. The large eelgrass beds in Portage Inlet are still an important herring spawning area and there are minor stocks of salmon, trout and oysters.

In recent years, a number of schemes have been proposed to improve the water quality of the upper basin. Two of these proposals involve the following hydraulic structures:

1. Construction of a dam between Victoria Harbour and the Gorge to prevent entry of polluted harbour water.⁽¹⁾ This proposal assumes that the contamination of the Gorge originates in Victoria Harbour and that any direct discharge from ineffective septic tanks into the waterway will soon be eliminated by sewers discharging into the Strait of Juan de Fuca. Even if the water in Victoria Harbour could somehow be kept clean, the dam would still be equally valuable in maintaining a constant water level and a higher water temperature in the upper basin. A two-mile long reservoir would thus be created in the centre of the city, a great recreational asset. The water would be either fresh or salt.

2. Construction of a canal between Portage Inlet and Esquimalt Harbour to flush the basin and to scour out the putrid Portage Inlet. A tempting ravine for this project already exists between Portage Inlet and the north-eastern shore of Esquimalt Harbour. A canal would link two scenic inlets with a protected waterway and open up entirely new possibilities for water tourism. However, a canal would not prevent polluted Victoria Harbour water from entering the Gorge and it would not maintain a constant level in the upper basin.

The two concepts still receive considerable attention from the municipal authorities and the provincial government. They are based on extensive ecological research, summarized in a publication by the Biology Department of the University of Victoria.⁽²⁾

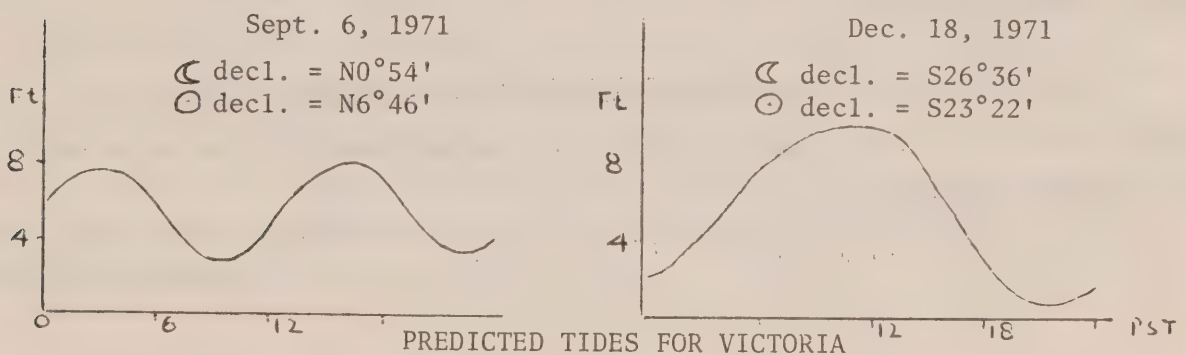
Either structure would change the basin's shape and consequently its response to the tides in the adjacent Strait of Juan de Fuca.

This report examines possible changes in tidal behaviour as a result of the proposed structures. A numerical model is developed and tested for the existing estuary and then modified to include the dam and the canal.

TIDAL CHARACTERISTICS

Tides in the approaches to Victoria Harbour are mixed (either diurnal or semi-diurnal). At its latitude of $48\frac{1}{2}^{\circ}\text{N}$, the Strait of Juan de Fuca has a tidal pattern which is not only affected by the relative positions of the moon and the sun but also by their declination. Mainly because of the moon's declination, the field of tide-producing forces is rarely symmetrical with respect to the poles of the earth, resulting in different amplitudes of two successive daily high waters and low waters. This "diurnal inequality" is most pronounced when the moon is at its extreme declination (either 28°N or 28°S). It may then obscure one of the two daily low waters, giving the tide a "diurnal" appearance.

In the Strait of Juan de Fuca, the declinational effect is at its greatest near Victoria. The diurnal character of the Victoria tides becomes particularly pronounced when the sun and moon are simultaneously at their maximum declinations, as may be illustrated by the following sketch:



For the two selected dates, the moon's phases alone would suggest identical spring tides; clearly, the tides near Victoria respond more to the moon's declination than to the moon's phase.

The tidal range is 9.3 feet for large tides. ⁽³⁾

The upper basin debouches into the harbour through a very narrow passage, the Gorge Narrows or Gorge Bridge (fig. 1). It is the interaction between the mixed tides and this constriction which gives this estuary its peculiar tidal characteristics.

The tides are distinctly diurnal for about 15 days per month. During these days, the harbour level is at its highest for several hours, permitting the upper basin to fill up to the same level. However, when the tide goes out, the harbour level falls rapidly, followed much more slowly by the upper basin because of the constriction. Long before the upper basin has "caught up" with the harbour, the harbour level starts to rise again. This contrast is illustrated by the two diurnal tide curves (June 9-10) in figure 8.

Because of its smaller range, a semi-diurnal tide will produce low waters, which are more uniformly distributed throughout the estuary. The high waters will then be of shorter duration and consequently a semi-diurnal high in Portage Inlet will be somewhat below that in Victoria Harbour, see figure 8 for June 1-2.

These peculiar tidal characteristics are reflected by the chart datum, which is 4.5 feet lower for Victoria Harbour than for the upper basin west of Gorge Bridge.

THE MODEL

Although the shape of the outer harbour would suggest a two-dimensional model, the observed currents in this part of the estuary are so small that acceleration and velocity components in transverse directions may be ignored. Therefore, a one-dimensional model was considered sufficiently accurate. Both flow and density are assumed vertically homogeneous.

Other assumptions are:

- The effects of wind and barometric pressure are neglected.
- Centrifugal forces in bends are ignored.
- Fresh water runoff is neglected.
- The calibration of the model excludes the possibility of super critical flow in the Gorge Narrows, which an extreme spring tide might bring about during short periods.
- The tidal input (seaward boundary condition) is assumed to be truly represented by one tide gauge on the east shore of the harbour entrance; in other words, the tides are assumed to be uniform across the one-half mile wide entrance.

The tidal computations are based on the one-dimensional shallow-water wave equations which have been derived in numerous textbooks (eg Lamb⁽⁴⁾ and Dronkers⁽⁵⁾).

$$\text{Equation of Continuity: } \frac{\partial Q}{\partial x} + W \frac{\partial h}{\partial t} = 0,$$

where Q is the discharge in ft³/sec in x-direction, W is the width of the water surface in feet, h the elevation of the water surface above a reference level (geodetic datum in this report), and x and t are the variables for distance and time.

$$\text{Equation of Motion: } \frac{\partial u}{\partial t} + u \frac{\partial u}{\partial x} = -g \frac{\partial h}{\partial x} - g \frac{u|u|}{c^2 d}$$

where u is the water velocity in x -direction, g the acceleration of gravity in feet/sec^2 , d is the actual water depth in feet and c the deChezy coefficient in $\text{feet}^{\frac{1}{2}}$ per second.

Introducing the cross-sectional area A in ft^2 and putting $Q = uA$, we have:

$$\begin{aligned} \frac{1}{A} \frac{\partial Q}{\partial t} - \frac{Q}{A^2} \frac{\partial A}{\partial t} + \frac{Q}{A} \left\{ \frac{1}{A} \frac{\partial Q}{\partial x} - \frac{Q}{A^2} \frac{\partial A}{\partial x} \right\} &= \\ &= -g \frac{\partial h}{\partial x} - g \frac{Q|Q|}{A^2 C^2 d} \end{aligned}$$

The two differential equations are solved by an explicit finite-difference method⁽⁶⁾, which may be summarized as follows:

The differential equations of continuity and motion are rewritten in finite-difference form $(\Delta x, \Delta t)$ and solved at the intersections of a time-space grid, bounded by the initial conditions (x -axis) and boundary conditions (t -axes) at each end of the model. After comparison of the results with actual field data (water levels and currents), the friction coefficient C is adjusted; the procedure is repeated until the predicted values agree with the observed data.

The method is called "explicit" because during each computation, only one unknown is calculated from a set of previously obtained values, while an "implicit" scheme derives at once all values of Q and h at level $t + \Delta t$ from the known ones at level t , with a large number of simultaneous equations. For the Victoria model, an explicit scheme was chosen because it is generally accepted to be the most useful approach.

SCHEMATIZATION

The estuary was divided into sections, each section or "block" having constant dimensions (figure 2). The section lengths, however, varied with the depth and were further adjusted so that the section lines agreed with the locations of field measurements. This approach is a departure from the conventional explicit scheme which uses equal section lengths. A more detailed discussion on the advantages and limitations of the use of unequal section lengths in an explicit scheme will follow in a separate paper.

The representative depth and width of each section in terms of the chart datum were obtained from a hydrographic field sheet by overlaying the soundings with a transparent grid and tabulating the average sounding per square. The depth was calculated by dividing the sum of these average soundings by the total number of squares and the width followed from division of the surface area (i.e. the total number of squares multiplied by a scale factor) by the section length. To facilitate calculations of the cross-sectional area, the depth was adjusted in terms of the geodetic datum. In the model, geodetic datum is used as a reference level for tidal heights because it remains constant throughout the system, while Chart Datum changes at Gorge Narrows (page 4).

The section width B at chart datum is assumed to be the width of the conveyance channel. The schematization includes shoals by allowing the section width to increase to a maximum value at a level determined from a hydrographic chart.

To avoid abrupt and unrealistic changes in cross-sectional areas, the dimensions of the sections were smoothed out as in figure 6, which also shows the notation used in the difference equations.

Referring to figure 5, GB , B , BW , $BMAX$ and CD were all taken from the chart. They characterize each section and are part of the data input to the computer program.

THE FINITE-DIFFERENCE EQUATIONS

Following standard procedures⁽⁷⁾, the first derivatives in these equations are approximated by central differences, e.g. $\frac{\partial h}{\partial x} = \frac{H_{m+1}^k - H_{m-1}^k}{2\Delta x}$, the truncation error being a function of $(\Delta x)^2$. k and m indicate the time and distance steps in the original matrix in figure 3, before the matrix is modified to save storage space (fig. 4). For the sake of clarity, the following derivation of the difference equation will refer to figure 3.

The equation of continuity is expressed in finite differences:

$$\frac{Q_{m+2}^{k-1} - Q_m^{k-1}}{\Delta x_m + \Delta x_{m+1}} + W_{m+1}^{k-1} \cdot \frac{H_{m+1}^k - H_{m+1}^{k-2}}{2\Delta t} = 0.$$

The first sections are relatively long (fig. 2) and might make the term $\frac{\partial Q}{\partial x}$ inaccurate in finite-difference form. Therefore, the equation of motion is rewritten as follows:

$$\frac{\partial Q}{\partial x} \text{ is replaced by } -W \frac{\partial h}{\partial t} \text{ (from continuity).}$$

Subsequently putting $\frac{\partial A}{\partial t} = \frac{\partial A}{\partial h} \cdot \frac{\partial h}{\partial t}$, we have:

$$\begin{aligned} \frac{1}{gA} \frac{\partial Q}{\partial t} - \left(\frac{\partial A}{\partial h} + W \right) \frac{Q}{gA^2} \frac{\partial h}{\partial t} - \frac{Q^2}{gA^3} \frac{\partial A}{\partial x} = \\ = - \frac{\partial h}{\partial x} - \frac{Q|Q|}{C^2 A^2 d} \end{aligned}$$

The term $\frac{\partial A}{\partial h}$, the change in cross-sectional area in terms of the water surface elevation was entered in the computer program as B , the width of the conveyance channel. This substitution assumes that all motion in x -direction occurs in the conveyance channel (see figure 5), a simplification which might not hold in an estuary with large shoaling areas.

"W" accounts for shoals and is programmed for three conditions:

- a) The water level is below chart datum;
- b) The shoals are partly flooded;
- c) The shoals are completely flooded (the latter case is sketched in figure 5).

The difference equation of motion can now be formulated as:

$$\frac{1}{gA_m^k} \frac{Q_m^{k+1} - Q_m^{k-1}}{2\Delta t} - (B + W)_m^k \frac{Q_m^{k+1}}{g(A_m^k)^2} = \frac{(H_{m+1}^k + H_{m-1}^k) - (H_{m+1}^{k-2} + H_{m-1}^{k-2})}{4\Delta t}$$

$$- \frac{Q_m^{k-1} Q_m^{k+1}}{g(A_m^k)^3} \cdot \left(\frac{A_{m+1}^k - A_{m-1}^k}{\Delta x_m + \Delta x_{m-1}} \right) = - \frac{H_{m+1}^k - H_{m-1}^k}{\Delta x_m + \Delta x_{m-1}} - \frac{Q_m^{k+1} |Q_m^{k-1}|}{(C_m)^2 (A_m^k)^2 D_m^k}$$

where Q_m^{k+1} is the only unknown term since all others pertain to previous time steps or to data input. The non-linear terms Q^2 have been linearized by using the approximation $Q_m^{k-1} Q_m^{k+1}$. Note that the de Chezy coefficient C may vary with each section.

With the two finite-difference equations, we can compute H at the odd points in x -direction and at the even points in t -direction; and Q at the even points in x -direction and at the odd points in t -direction. This "leap-frog" method is illustrated by figure 3 (top), which also suggests a more efficient use of the available computer memory. To save storage space, the conventional matrix is compressed (figure 3 bottom) and the rows are relabelled (by eliminating the rows with subscripts $(k + 2i + 1)$ and reassigning the $(k + 2i)$ rows with numbers $(n + i + 1)$, where i is any integer).

Using the notation of figure 4, we can now write the equations of continuity and motion in their final form:

Continuity:

$$H_{m+1}^{n+1} = H_{m+1}^n - \left\{ 4\Delta t \cdot (Q_{m+2}^n - Q_m^n) \right\} \cdot \left\{ (W_{m+1}^n + W_{m+2}^n) \cdot (\Delta x_m + \Delta x_{m+1}) \right\}^{-1}.$$

Note that $\frac{1}{2}(W_{m+1} + W_{m+2})$ represents the modified width at section line (m+1) shown in figure 6.

Motion:

$$Q_m^{n+1} = \left\{ \frac{\Delta x_m + \Delta x_{m-1}}{g \cdot \Delta t \cdot (A_m^{n+1} + A_{m+1}^{n+1})} Q_m^n - (H_{m+1}^{n+1} - H_{m-1}^{n+1}) \right\} \cdot \left\{ \frac{\Delta x_m + \Delta x_{m-1}}{g \cdot \Delta t \cdot (A_m^{n+1} + A_{m+1}^{n+1})} + \frac{(\Delta x_m + \Delta x_{m-1}) \cdot |Q_m^n|}{C_m^2 \cdot \left(\frac{A_m^{n+1} + A_{m+1}^{n+1}}{2} \right)^2 \cdot \left(GB_m + \frac{H_{m+1}^{n+1} + H_{m-1}^{n+1}}{2} \right)} - \frac{Q_m^n \cdot \left\{ (A_{m+1}^{n+1} + A_{m+2}^{n+1}) - (A_m^{n+1} + A_{m-1}^{n+1}) \right\}}{g \cdot \left(\frac{A_m^{n+1} + A_{m+1}^{n+1}}{2} \right)^3} - \frac{(\Delta x_m + \Delta x_{m-1}) \cdot (B_m^{n+1} + W_m^{n+1} + B_{m+1}^{n+1} + W_{m+1}^{n+1})}{8g \cdot \Delta t \cdot \left(\frac{A_m^{n+1} + A_{m+1}^{n+1}}{2} \right)^2} \cdot \left[(H_{m+1}^{n+1} + H_{m-1}^{n+1}) - (H_{m+1}^n + H_{m-1}^n) \right] \right\}^{-1}.$$

BOUNDARY CONDITIONS

The boundary conditions of the equations are the observed tides at the harbour entrance (section line 1, fig. 2) and zero discharge at the head of Portage Inlet (section line 42).

At the harbour entrance, tidal records were obtained from an Ottboro tide gauge which was installed at Ogden Point in the spring of 1971 and maintained for several weeks. Reference to a geodetic benchmark (#737-J at the foot of Broughton Street) was established.

INITIAL CONDITIONS

The estuary is initially considered to be in equilibrium, i.e. Q_m and H_{m+1} are both zero at $t = 0$. The effects of an inaccurate estimate of the initial tidal heights and discharges disappear quickly.

STABILITY AND THE TIME STEP

An essential condition for the successful functioning of an explicit scheme is its stability. Numerical errors introduced by rewriting the differential equations in finite-differences should not progressively amplify.

The stability requirement has been investigated in detail by Leendertse.⁽⁸⁾ For a one-dimensional explicit scheme, the criterion for unconditional stability is found to be

$$\frac{\Delta x}{\Delta t} \geq C;$$

C is the velocity of propagation of a tidal wave. We set $C = \sqrt{gh}$, where h is the greatest water depth in the system.

Since the (minimum) section length Δx had already been established by the schematization, the stability depended on the choice of the time step. To find the optimum value of Δt , the model was run with Δt varying between 40 seconds and 5 seconds.

A time step of 10 seconds was finally selected to satisfy the stability criterion.

It should be emphasized that the interval $2\Delta t = 20$ seconds in the modified computer scheme (fig. 4) applies to the time between two consecutive computations of H or Q . Compressing the matrix as shown in figure 4 only affects the notation, not the leap-frog method! For instance, Q_m^{n+1} still occurs one time step later than H_{m-1}^{n+1} or H_{m+1}^{n+1} .

THE COMPUTER PROGRAM

The program was written in FORTRAN and executed on a teletype terminal to the UNIVAC 1108 machine operated by Computer Sciences of Canada at Calgary, Alberta. Plotting routines were carried out on a CALCOMP 563 plotter interfaced with a Hewlett-Packard 2116B computer (16k). The flow chart for the program is shown in figure 23.

CALIBRATION OF THE MODEL: THE FRICTION COEFFICIENT

The model was verified by comparison of the computed tidal heights and currents with observed values recorded at a number of stations along the estuary. The friction coefficients C for all sections were then adjusted until the model reproduced the recorded data as closely as possible for the corresponding boundary conditions. The model was run for a large tide (June 9 and 10, 1971, see figure 8) and calibrated with tidal records. After calibration, it was tested with current observations at a number of locations and for different dates.

Figure 9 illustrates how the friction coefficients were tuned by comparing preliminary teletype plots of model-generated and observed tides. These tides were plotted simultaneously for two stations and for different values of C. The right-hand output obviously reflects a better choice of C than the left-hand output, particularly for the "Porters" tides.

The calibration was continued in this fashion until the model output and the actual tidal data agreed within 0.2 feet at all gauge stations (typical discrepancies were 0.1 feet). Finer tuning of the friction coefficient might well have produced a higher precision. However, this refinement would have involved much costly computer time, and was not warranted for the purposes of the model.

The final values of the friction coefficients varied from 20 ft.^{1/2}/sec for the very shallow Portage Inlet to 50 ft.^{1/2}/sec for Victoria Harbour. The low friction coefficient (high friction term) in the upper basin is not surprising when one considers obstructions such as the heavily trestled Craigflower Bridge and the abundant marine vegetation in Portage Inlet.

The coefficient C in the friction term $\frac{g u^2}{C^2 d}$ is referred to in this report as the "de Chezy" coefficient to conform with the literature on estuary modelling. However, it is a misnomer. The de Chezy coefficient originates in river hydraulics and depends mainly on the nature of the bed material. It is often expressed as $C = \frac{1.49}{n} R^{1/6}$ (9), where n is an empirical factor for bed material and R the hydraulic radius. This formula strictly considers the roughness of the boundary materials. The model's friction coefficient also includes the effect of bridge framework, pilings, logbooms etc. upon the water movement and may be much lower than the conventional de Chezy coefficient.

After calibration with vertical tides, the model was tested by current measurements for different tidal cycles.

Figures 10 and 11 show comparisons between computed and observed flows at two bridges, respectively in the lower and upper basin. The "observed discharges" were obtained by multiplication of the mean of several point measurements by the estimated cross-sectional area. There seems to be closer agreement between computer output and field data at Craigflower Bridge than at Johnson Street Bridge. This difference may be due to a better estimate of the mean current at Craigflower Bridge, where the flow is transversely much more uniform. Both model output and field data show large fluctuations in the flow at Johnson Street Bridge, which will be discussed later.

PREDICTED EFFECT OF A DAM UPON THE TIDES IN VICTORIA HARBOUR

The site of the proposed dam is assumed to be just west of the model's section line 10 (fig. 2). Being even-numbered, this line corresponds with grid points where discharges (Q) are calculated in the leap-frog scheme.

The effect of the dam on the Victoria tides can be evaluated by restricting the model to the first nine sections and setting a new "upstream" boundary condition $Q = 0$ at section line 10.

Using the previously estimated friction coefficients, the model can now be run again and its output at a section line in the harbour compared with that of the original model without a dam.

Figure 12 compares the model-produced tidal heights at section line 5 without and with dam. Although the two outputs do not differ in height or phase, the dam seems to generate a continuous low-amplitude oscillation of about 30 minutes, which does not resemble the normal fluctuations caused by an inaccurate estimate of the initial conditions. The model-produced discharges at Johnson Street Bridge (section line 6) confirm this observation clearly, vid figure 13.

It might be argued that the oscillation is not merely a resonance phenomenon but is a direct result of a large variety of tidal fluctuations at the harbour entrance, i.e. the downstream boundary condition.

To examine this possibility, the observed tides at Ogden Point are replaced by a cosine function representing the M-2 tide at Victoria, followed by a jump discontinuity to a zero tide (fig. 14). When the dam is included in the model, the flow at Johnson Street Bridge generated by this function exhibits again a very distinct period of 29 minutes, which is even more pronounced after the cosine function is abruptly discontinued to produce a one-foot shock. The

expression for harbour resonance $T = \frac{4L}{gh}$ (where L is the distance to the dam and T the resonance period) would produce a resonance period of 32 minutes, disregarding Raleigh's mouth correction.¹⁰ Raleigh's correction, although it may not apply to a numerical model, would increase the period to 37 minutes.

Without the dam, the shock does not produce a distinct resonance. A high-frequency signal (T = 7 minutes) superimposed upon both outputs plotted in figure 14 is almost certainly due to the schematization. A change in section lengths eliminates this signal but alters neither period nor amplitude of the 29 minute oscillation generated by the dam.

The frequency components of the flow in Victoria Harbour can be identified more clearly with a spectral analysis, as illustrated in figures 15 and 16. The plots are Power Spectra of the model-produced discharges at Johnson Street Bridge for June 9, 1971 and March 3, 1968. The computer program used for this method was developed in 1970 by the Insitute of Oceanography at the University of British Columbia. The observed tides for these dates are the boundary conditions.

Without the dam, the two Spectra are reasonably similar, with peak frequencies near 1.5, 4 and 5 cycles per hour. When the dam is included in the model, both plots show a very distinct peak frequency of 2.1 cycles per hour (T = 28.6 minutes).

Figure 17 is a similar spectral analysis of the observed tides for the same dates, to compare input and output frequencies of the model. The spectrum for June 9, 1971 is not conclusive. However, the spectral analysis of the March 1968 observed tides agrees rather well with that of the model-produced discharges at Johnson Street Bridge. It should be pointed out that the June 1971 tides were taken from Ogden Point gauge records, at the harbour entrance, while the March 1968 data were obtained from the Victoria gauge which is well inside the harbour and more susceptible to resonance. The tidal records

for March 3-5, 1968 were selected for spectral analysis because they show some interesting short-period seiches, which are clearly reflected in the model.

To examine the harbour resonance more closely, two current meters were anchored under the Johnson Street Bridge, just outside the navigation channel. They recorded currents between the 3rd and 10th of November, 1971. One current meter, a Geodyne, had a sampling interval of four seconds (averages over 160 seconds) and the other, an Anderaa, had a ten minute sampling interval.

Without aliasing, the Anderaa's records would barely detect the 20 to 40 minute harbour resonance periods. The Anderaa was therefore mainly used to check the performance of the much more sophisticated Geodyne current meter.

A spectral analysis of the Geodyne data is shown in figure 18. The spectrum appears different from those in figures 15 to 17 because it is derived from a program developed by the Geodyne manufacturers which does not show confidence intervals. The most conspicuous peak frequency of 1.85 cycles per hour (a period of 32 minutes) agrees closely with that found on the tidal records of March 3-5, 1968 (figure 17). The other peaks agree reasonably well, although the tidal records show peaks at the higher frequencies (4.1 and 5.2 cycles per hour), which the current meter did not seem to detect. It should be noted that the directional unit of the Geodyne failed almost immediately after the meter was put down. This mishap had no effect upon the spectral analysis since the flow reversals were quite distinct and could easily be reconstructed from the records of the Anderaa current meter. The spectral analysis of the Anderaa data shows distinct peak frequencies at 1.2 and 2.6 cycles per hour; which correspond to those of the Geodyne records.

The results of the model computations of the effect of the dam may then be summarized as follows:

There is sufficient evidence that the proposed dam will enhance a seiche with a period of 29 minutes. Under normal tidal conditions, this seiche will hardly be noticeable. However, a seiche induced by the passage of a weather system or perhaps an earth tremor will generate stronger harbour currents and continue to oscillate much longer than under the same conditions without a dam. For instance, in both cases a one-foot shock at Ogden Point will set off a flood current near Johnson Street Bridge with a peak of about four knots. When the dam is included, the current will continue to oscillate for several hours. It will decrease to about one-half knot in both directions after five hours. However, without the dam the current will become virtually negligible after the first oscillation, since the energy of the tidal wave dissipates rapidly in the Gorge and Portage Inlet.

SOME ASPECTS OF THE PROPOSED PORTAGE CANAL

Although the construction of a canal between Portage Inlet and Esquimalt Harbour seems much less practicable than the building of a dam between the Upper Harbour and the Gorge¹, only minor program changes are needed to include the canal in the model and permit a cursory study of its effect upon the tides.

To connect Portage Inlet with Esquimalt Harbour, the canal would have to be about 2000 feet long. The schematization is therefore modified simply by extending the upstream portion of the model to Esquimalt Harbour with three sections, as figure 2 clarifies. The sections are each 670 feet long, 100 feet wide, and 10 feet deep with respect to geodetic datum. The tides in Esquimalt Harbour, assumed to be equal to those at Ogden Point now form the upstream boundary condition. The friction coefficient is set at $60 \text{ ft.}^{\frac{1}{2}}/\text{second}$.

The model examines the effect of the canal upon the water level in Portage Inlet, upon the currents in the Gorge and computes the flow in the canal itself.

Using the existing bottom configuration of Portage Inlet and Western Gorge, this version of the model fails: at a falling tide, the basin's out-flow will not be restricted by the Gorge Narrows but will find an additional passage through the canal into Esquimalt Harbour. Several sections in Portage Inlet and Western Gorge will consequently dry up during part of the tidal cycle, causing the term Q/A in the equation of motion to approach infinity. However, the model works when the term GB (see figure 5) is increased to ten feet for all shallow sections in the upper basin, in other words, after some considerable dredging.

For a clear comparison of the current velocities in the Gorge Narrows, a cosine function (the M-2 tidal constituent for Victoria) is used

as model input. The results are plotted in figure 20: the canal will reduce the maximum current velocity in the Gorge to one-half its present value, while the current in the canal itself will be about twice as strong as that in the Gorge (after construction of the canal). These figures are of a reconnaissance nature only, and are based on some broad assumptions.

Only a simple adjustment on the schematization enables the model to predict the currents in the canal if a dam is constructed between Gorge and Upper Harbour, in addition to the canal. This adjustment would omit the first nine sections, and set $Q=0$ at section line 9. A boundary condition at Esquimalt Harbour of the observed Victoria tides for 9 - 10 June 1971 would induce a maximum current of three knots in both flood and ebb directions. An M-2 tide would induce a maximum current of two knots in either direction.

As a matter of interest, the model then considers the possibility of dredging the entire upper basin to a depth (GB) of ten feet below geodetic datum. Figure 21 illustrates the effect of this operation: with the observed tides at Ogden Point for 9 - 10 June 1971 as the downstream boundary condition and $Q=0$ as the upstream boundary condition, the model predicts no change in the high water levels in Portage Inlet but a considerable drop of three feet of the low water levels. In other words, the chart datum of the upper basin would be lowered.

Figure 22 shows a considerable increase in discharge through the Gorge in both directions for the same conditions.

CONCLUSION

The construction of a dam below Gorge Narrows would amplify a seiche which normally is suppressed by the upper basin.

The proposed Portage Canal, unless regulated by locks, would, at low water, drain Portage Inlet and the Gorge into Esquimalt Harbour. To maintain circulation, the two waterways would have to be dredged. At falling tide, most of the upper basin would then discharge through the canal, reducing the ebb current in the Narrows to a rate which would make this passage navigable during all tidal phases.

REMARKS

To avoid discontinuity in the foregoing discussion, some significant approximations and assumptions in the model were dealt with only briefly. They will now be considered in more detail.

A unique feature of the tidal characteristics of the Victoria basin is the constriction at Gorge Narrows where at an outgoing tide the water level may drop more than four feet over a very short distance. During a preliminary observation of the flow in the Narrows at low-water spring tide, the average slope of the hydraulic grade line under the Gorge Bridge was estimated at 5%, with a correlative increase in current velocities from three to ten feet per second over a distance of less than 100 feet. Just east of the Gorge Bridge, the bottom slopes down steeply towards the harbour and the flow decelerates back to normal.

Mainly because of the considerable change in velocities in the Gorge Narrows, the convective acceleration $u \frac{\partial u}{\partial x}$ was included in the equation of motion. The term (also called the "Bernouilli" term) is often ignored in tidal computations of rivers and estuaries. To test its relative importance in the Victoria model, $u \frac{\partial u}{\partial x}$ was omitted for some typical boundary conditions. The results never differed by more than 3% from cases where the term was retained. The term is nevertheless maintained in the final program. Vertical accelerations and velocities are neglected since there was obviously no abrupt change in the water level.

The irregular bottom profile and strong turbulence in the transition zone made it difficult to establish conditions for critical flow. The Froude numbers computed from the available field data did not exceed 1. However, an extreme tidal range might create a hydraulic jump with a considerable loss of energy (a cubic function of the difference in water levels before and after the jump) and a discharge which depends on the critical depth ($Q = g^{1/2} b d_c^{3/2}$, where d_c = critical depth).

The equations of motion and continuity would still hold on both sides of the hydraulic jump but the transition zone should be considered separately with the vertical tides on each side as boundary conditions.

A detailed study of the Gorge Narrows would require two tide gauges at the Gorge bridge; they should preferably operate in December when a maximum tidal range may be expected. Currents and depths in the transition zone should be measured simultaneously.

In the equation of motion, the width of the conveyance channel is kept constant throughout a tidal cycle, while the height varies with the tides. In other words, all flow is assumed to pass through a rectangular cross section defined by this fixed width and variable height. No interchange of momentum is assumed to take place between the currents in the main channel and the currents to and from the flooding and drying regions, which are relatively small in the Victoria basin. The average width of the conveyance channel for each section was obtained from the chart by dividing the total water surface at chart datum by the section length.

Throughout a cross section, the flow is assumed to be uniformly distributed, both transversely and vertically, and the expression $Q = uA$ is based on this assumption when the velocity component u is replaced by the discharge Q in the equation of motion. However, preliminary current measurements at the Johnson Street Bridge over a grid of twenty feet (horizontal) by five feet (vertical) indicated that the surface current in the middle of the channel would be about twice as high as the mean flow for that particular cross section. Therefore, if the model would be required to predict surface currents (e.g. for pollution studies), additional field measurements must be made to relate surface currents to mean currents at selected sections.

In the canal program, the tidal input at section 45 was set equal to that at section 1, on the assumption that the tides in Esquimalt Harbour would be identical to those at Ogden Point. There would actually be a slight difference in range and phase between the tides in these two locations. A more comprehensive study of the feasibility of a canal would require an

additional tide gauge at the head of Esquimalt Harbour.

When the dam was included in the model, the observed tides at the harbour entrance for the existing system (without dam) were entered as the seaward boundary condition. This approach ignored the effect which the dam might have upon the tides at the harbour entrance. It would be more accurate to establish a boundary condition outside the harbour entrance, for instance by using tidal data derived from a future numerical model of the Strait of Juan de Fuca.

The schematization of the model introduces a few refinements which have been discussed in detail. The computational technique follows a proven method which has been treated in the literature⁽⁵⁾ and needs no further comment.

By its stepwise simulation of a tidal estuary, a one-dimensional numerical model may overlook features which a detailed physical model would detect; to minimize this possibility, the Victoria model was schematized with relatively small section lengths and time intervals. The report demonstrates how a variety of modifications in a flow regime can be examined by the same computer program with only minor adjustments. This flexibility is clearly an advantage of a mathematical model.

The results of the model analysis indicate that the harbour's tidal response will be an important factor in a future feasibility study of a dam in the Victoria basin. The need for such an investigation is further emphasized by the existence of harmful seiches in other harbours, e.g. Neah Bay (Washington), Los Angeles and Cape Town.⁽¹¹⁾ For instance, in certain parts of Los Angeles Harbour, ships have been damaged when they were surging and swaying as a result of horizontal oscillations.⁽¹²⁾

An approximate position of the proposed dam was used to compute the tidal response of the harbour. Once a decision has been made regarding the dam's exact location, the computer program can be adjusted accordingly.

ACKNOWLEDGEMENTS

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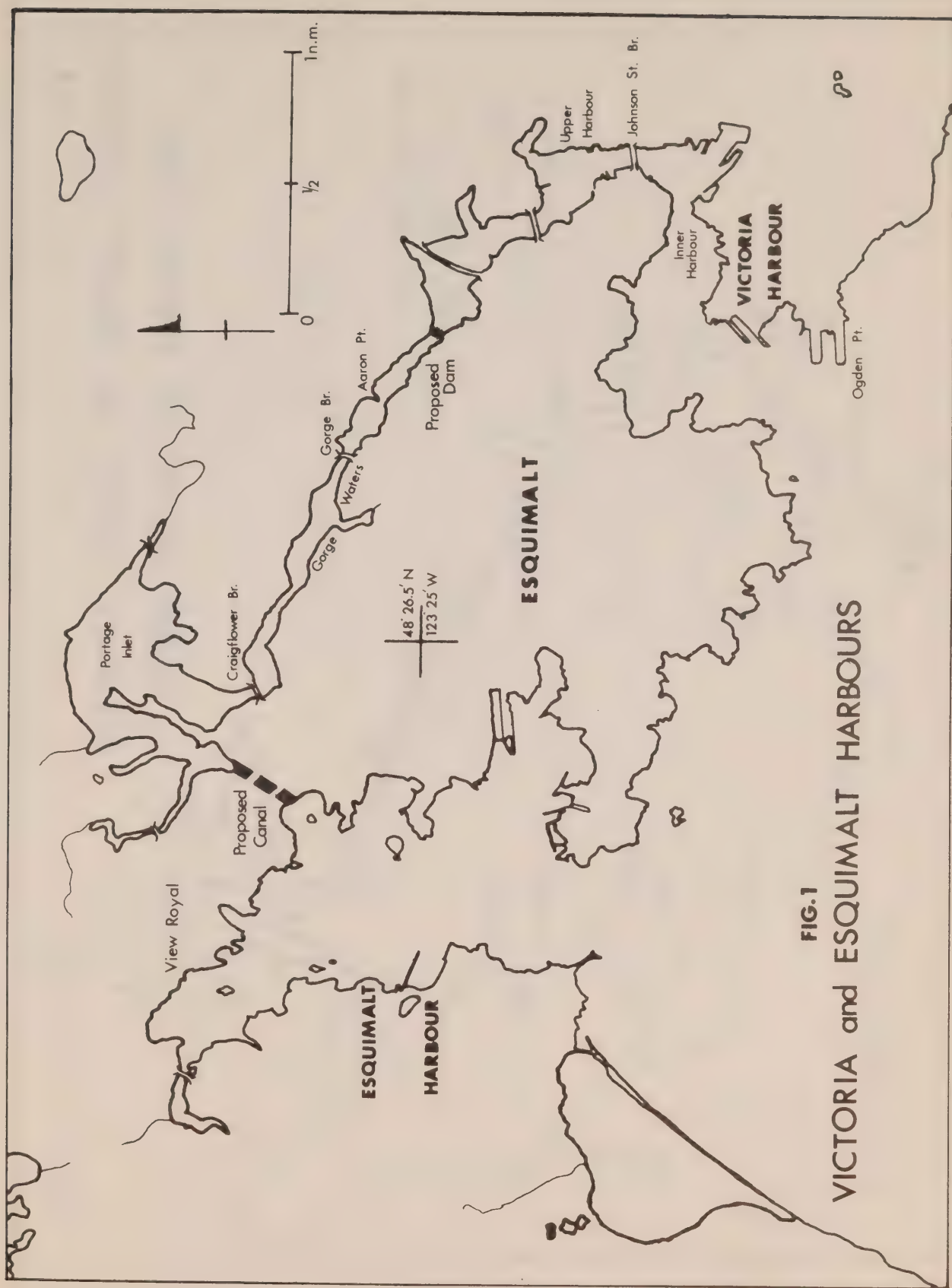


FIG.1
VICTORIA and ESQUIMALT HARBOURS

FIG. 2

NUMERICAL MODEL OF VICTORIA HARBOUR, GORGE WATERS and PORTAGE INLET

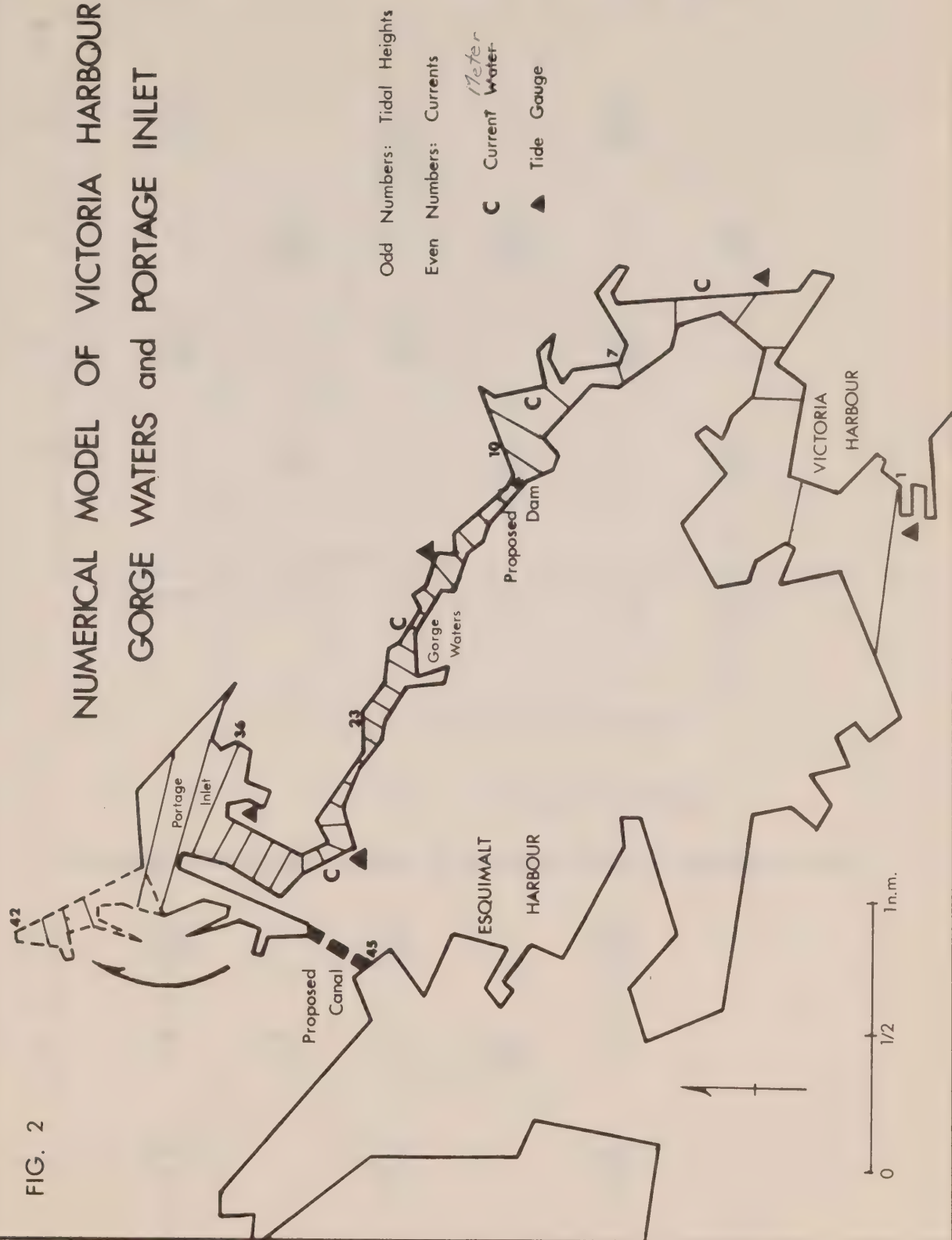
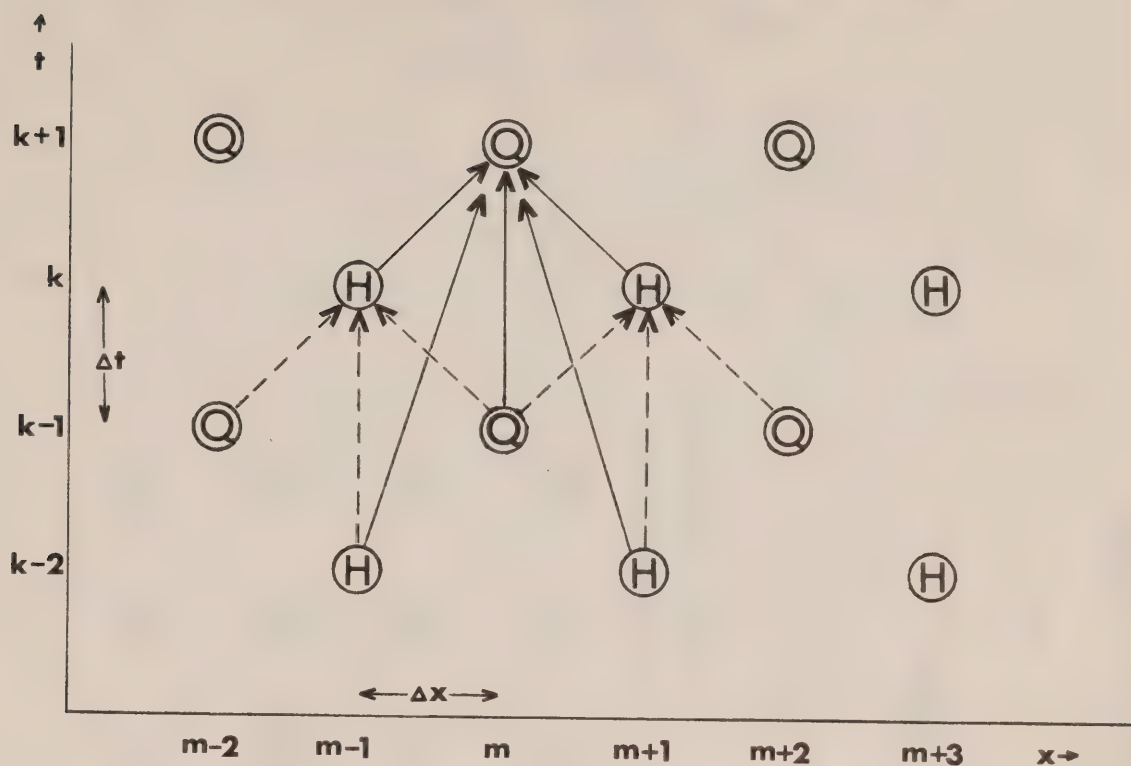


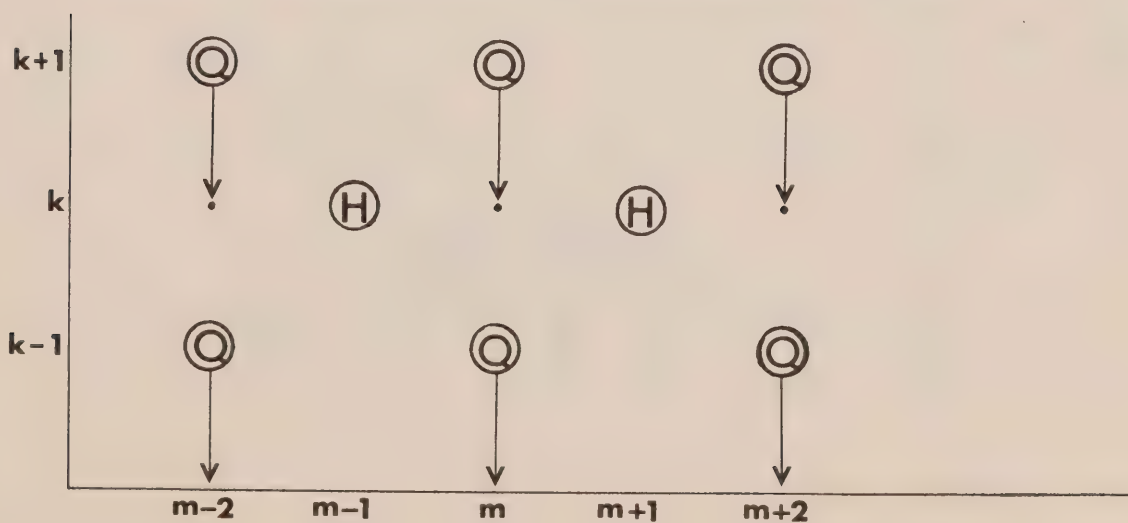
FIG.3 COMPUTATION SCHEME, EXPLICIT MODEL



—————→ eqn. of motion

-----→ eqn. of continuity

Compress Matrix by moving Q elements down to previous H-row



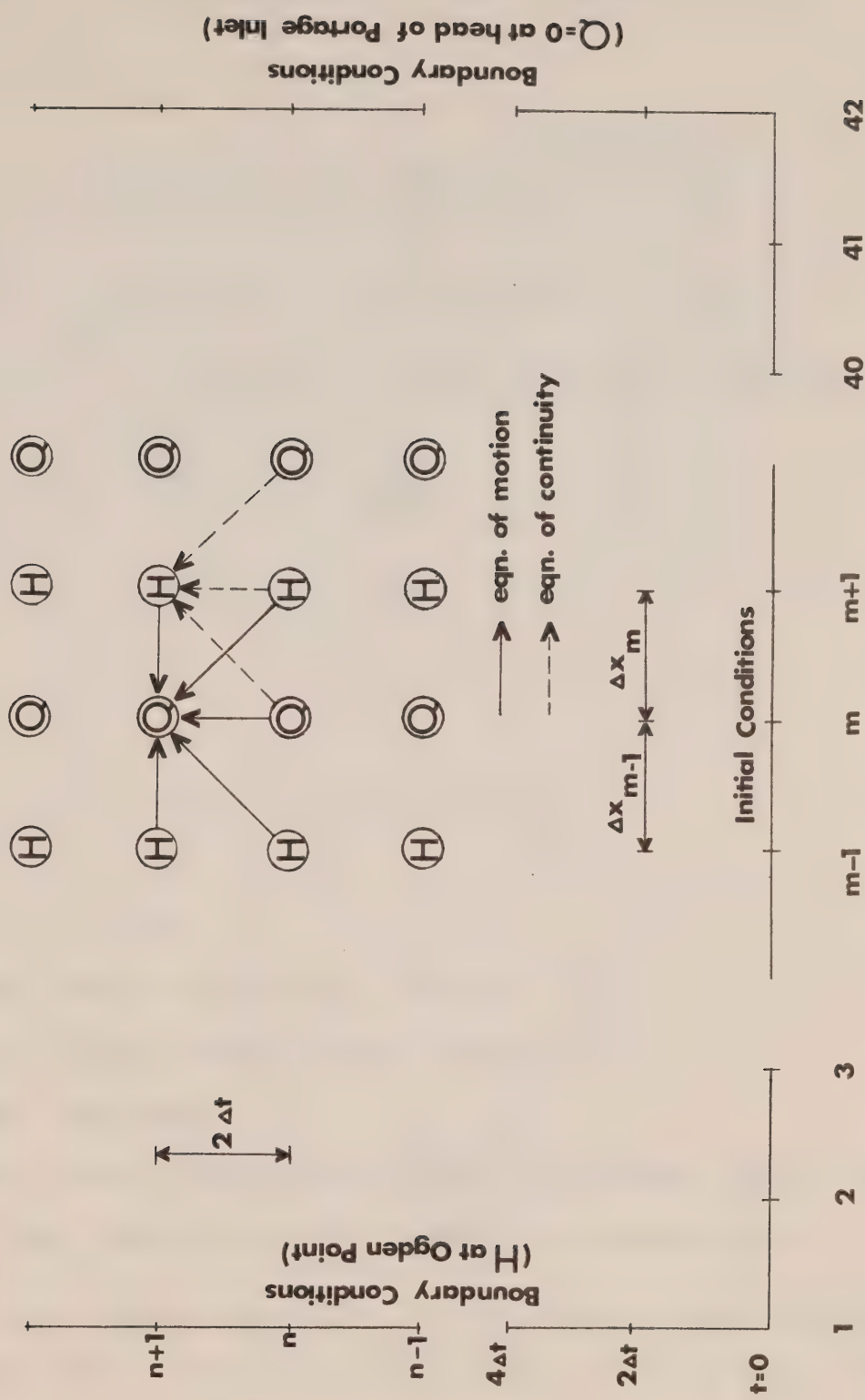
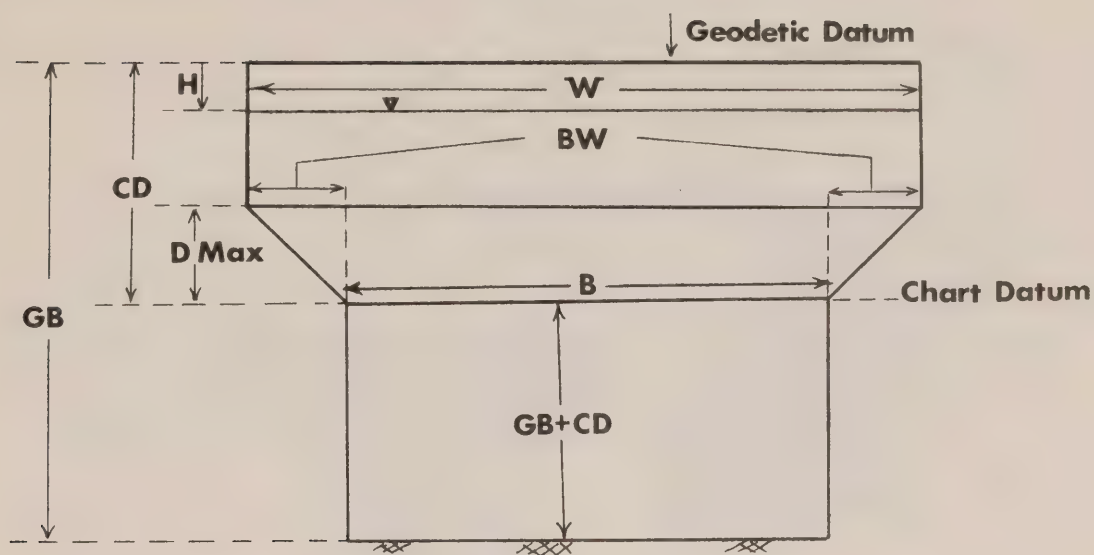


FIG.4 MODIFIED COMPUTER SCHEME

FIG. 5

SCHEMATIZATION OF SECTIONS



B - Mean width of a section at Chart Datum (fixed)

W - Mean width at time t (variable)

BW - Bank width (fixed)

GB - Distance between Geodetic Datum and bottom (fixed)

CD - Distance between Geodetic and Chart Datum (fixed)

DMax - Bank height (fixed)

H - Distance between Geodetic Datum and water level (variable; negative in figure)

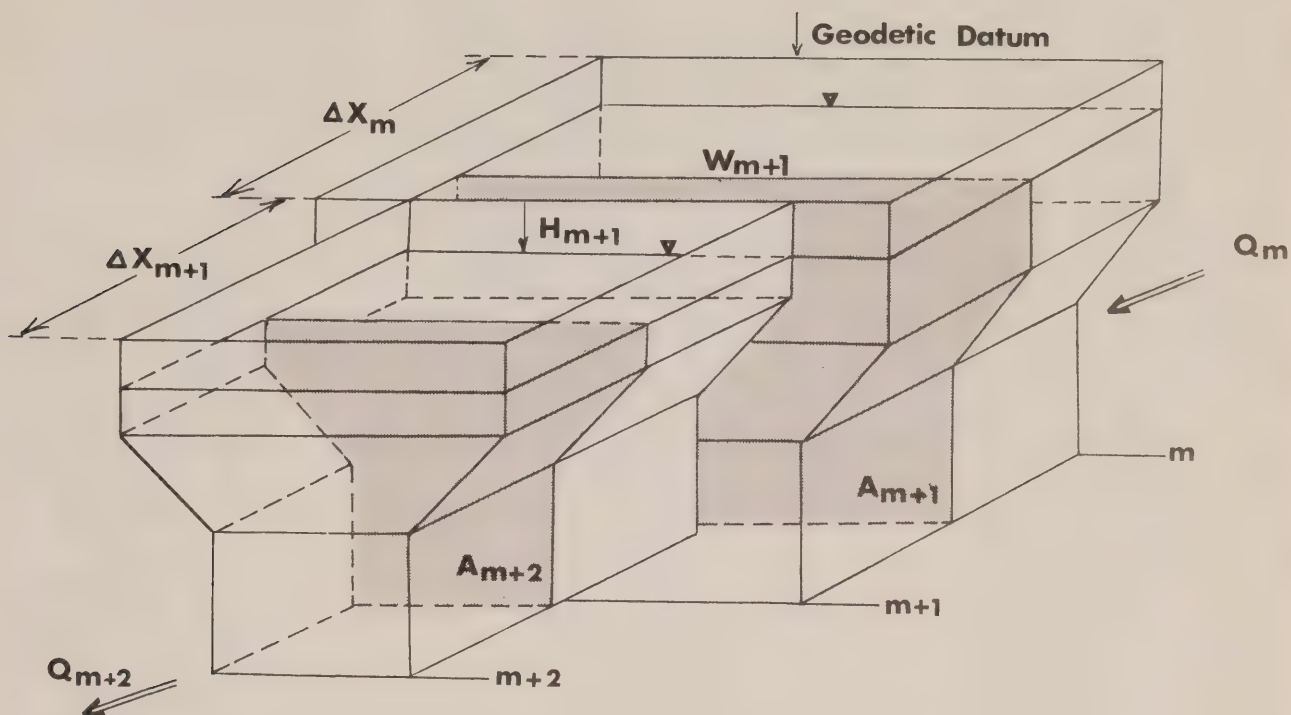
GB + CD - Depth below Chart Datum, obtained from hydrographic charts

CHART DATUM: East of Gorge (Section 17), Chart Datum is 6.16 feet below Geodetic Datum. West of Gorge, Chart Datum is 1.66 feet below Geodetic Datum.

FIG. 6

SMOOTHING OF CROSS-SECTIONAL AREAS

A) SCHEMATIZED SECTIONS:



B) MODIFIED $M+1$ SECTION:

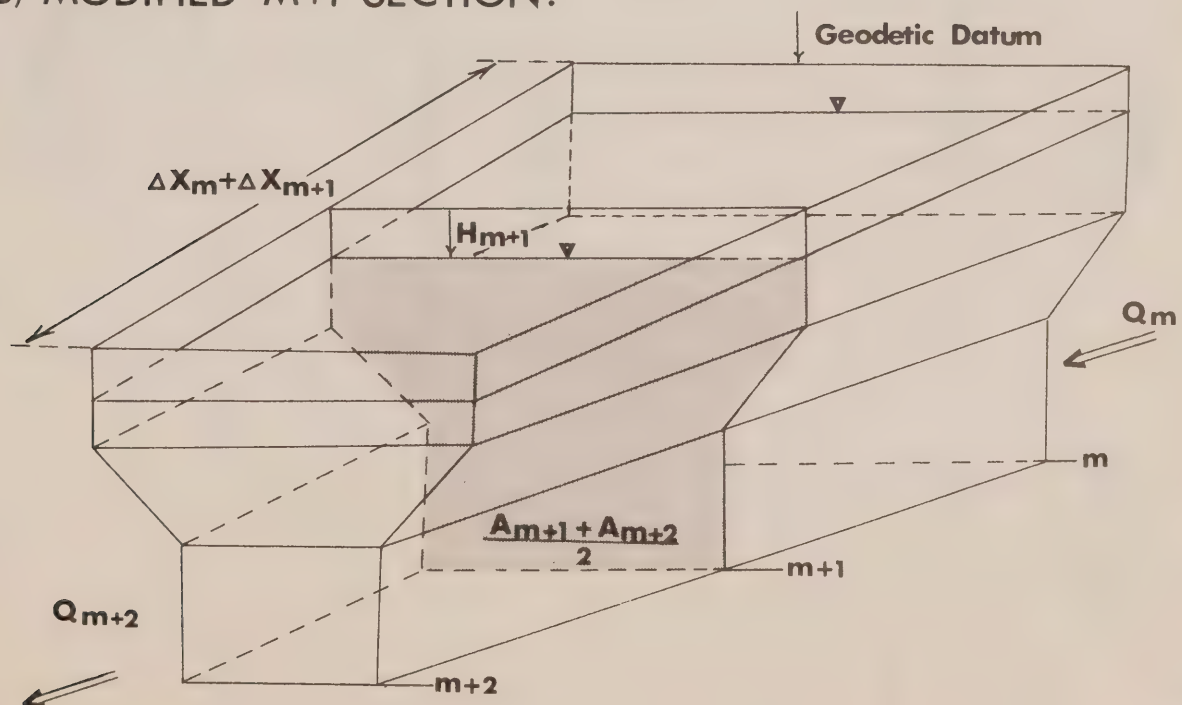


FIG. 7
VICTORIA HARBOUR TO PORTAGE INLET
 LONGITUDINAL PROFILE DERIVED
 FROM SCHEMATIZED SECTIONS

Horizontal Scale: 1 cm = 1500 ft

Geodetic Datum

Chart Datum

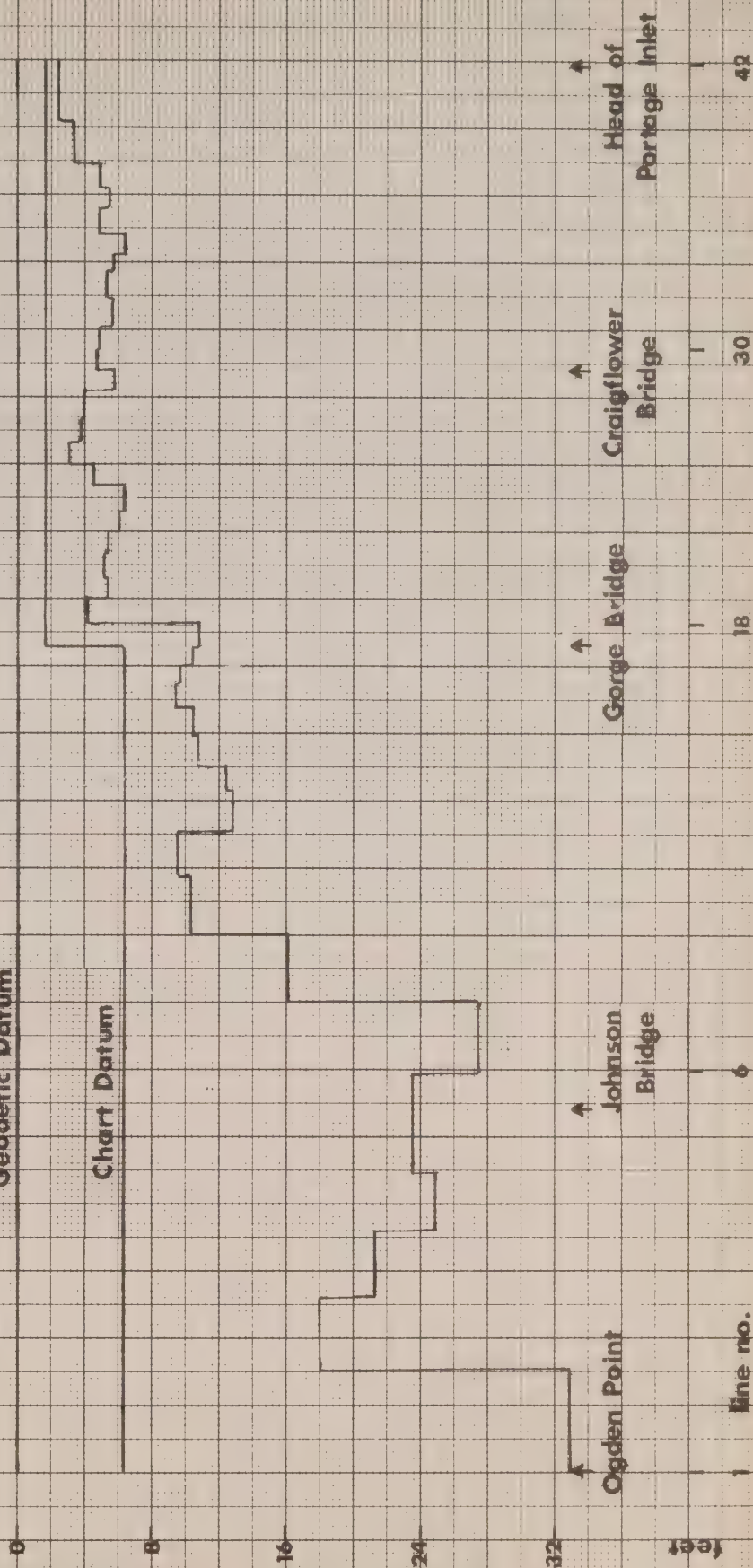


FIG. 8

OBSERVED

TIDAL HEIGHTS

VICTORIA HARBOUR, PORTAGE INLET,

JUNE 9-10, 1971: in black

JUNE 1-2, 1971: in red

Feet

6

4

2

0

-2

-4

-6

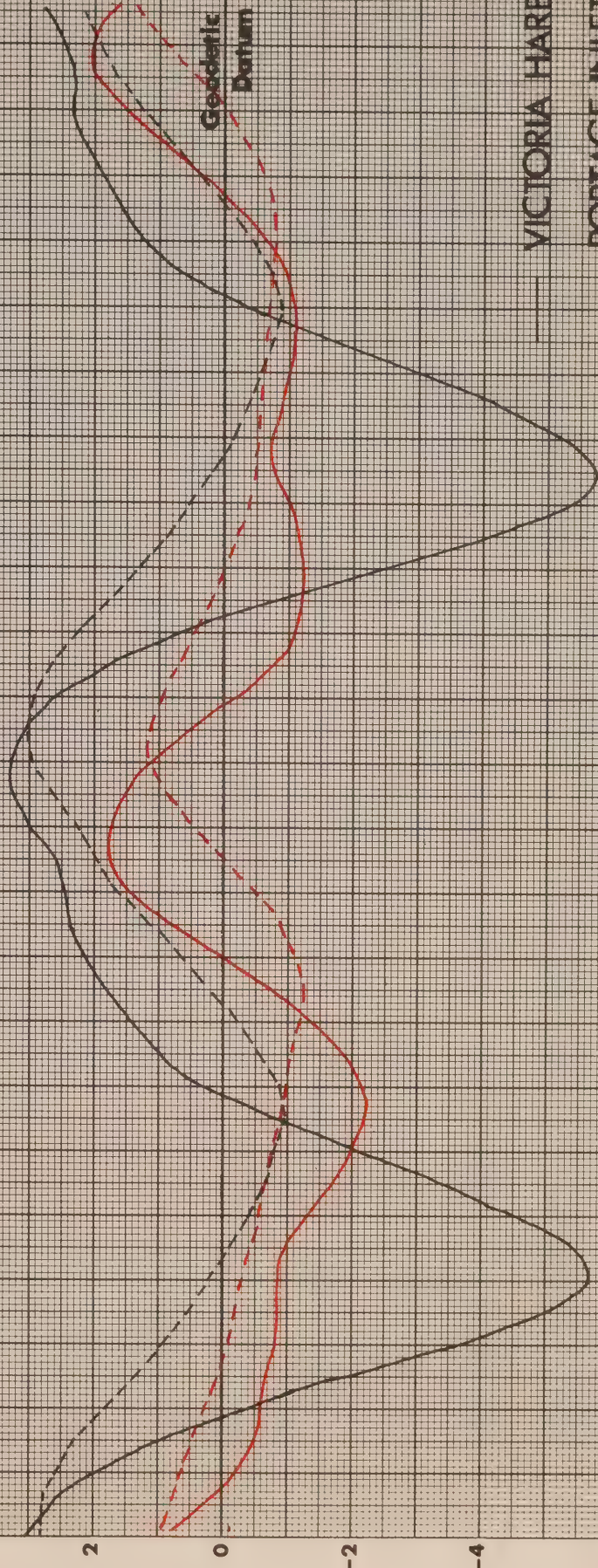
0100

12:00

24:00

12:00

24:00 PST



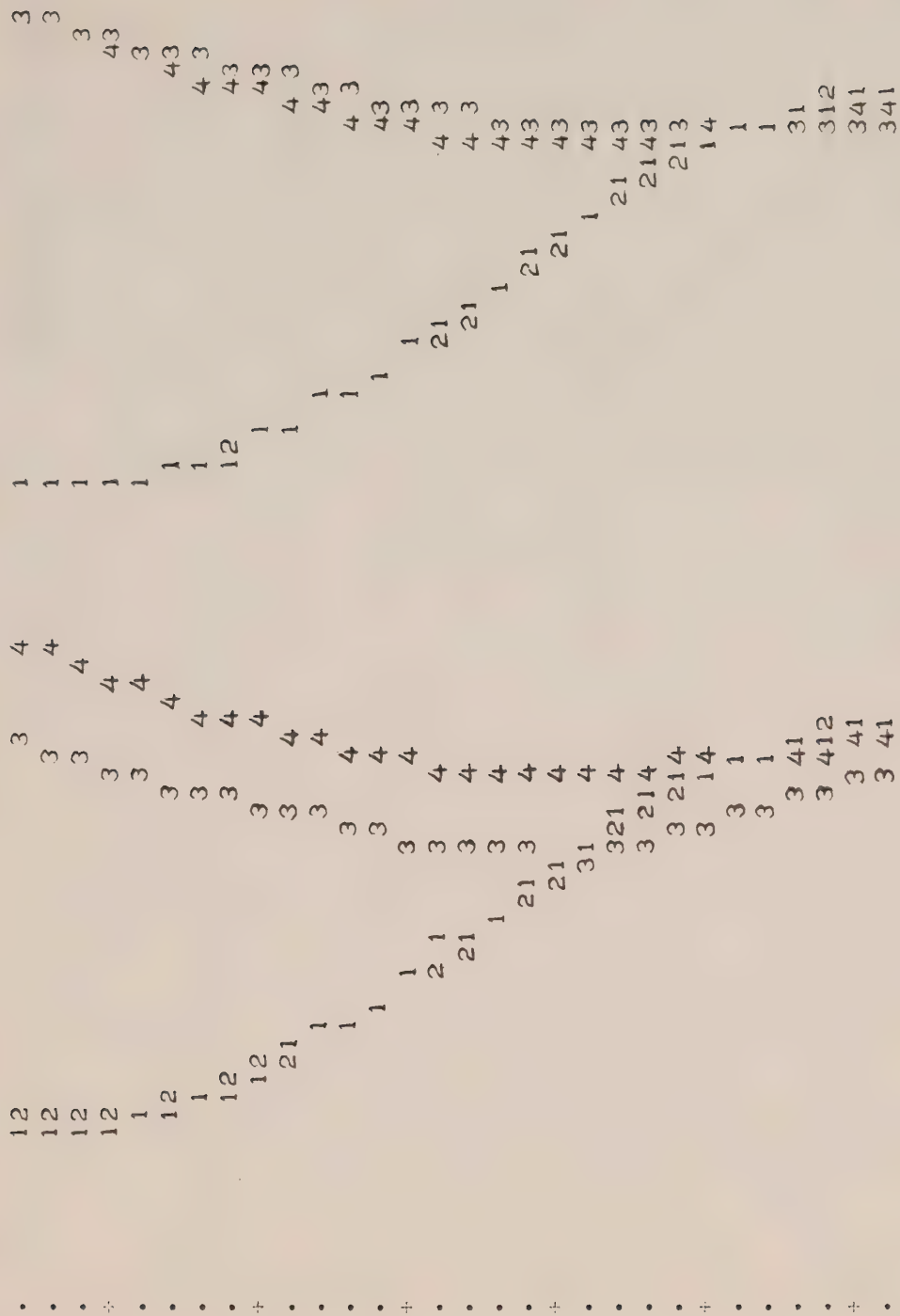


FIG. 9 DETERMINATION OF FRICTION COEFFICIENTS

PORTIONS OF TIDE GRAPHS

1. Aaron Point, model-generated
2. Aaron Point, observed
3. Porters, model-generated
4. Porters, observed

FIG. 10 MODEL VERIFICATION:

DISCHARGES AT
JOHNSON ST. BRIDGE

19th 20th JULY, 1971

flood

ebb

Q

(ft³/sec)

model-produced

observed

H

(ft)

OBSERVED TIDES AT VICTORIA (wrt GEODETIC DATUM)

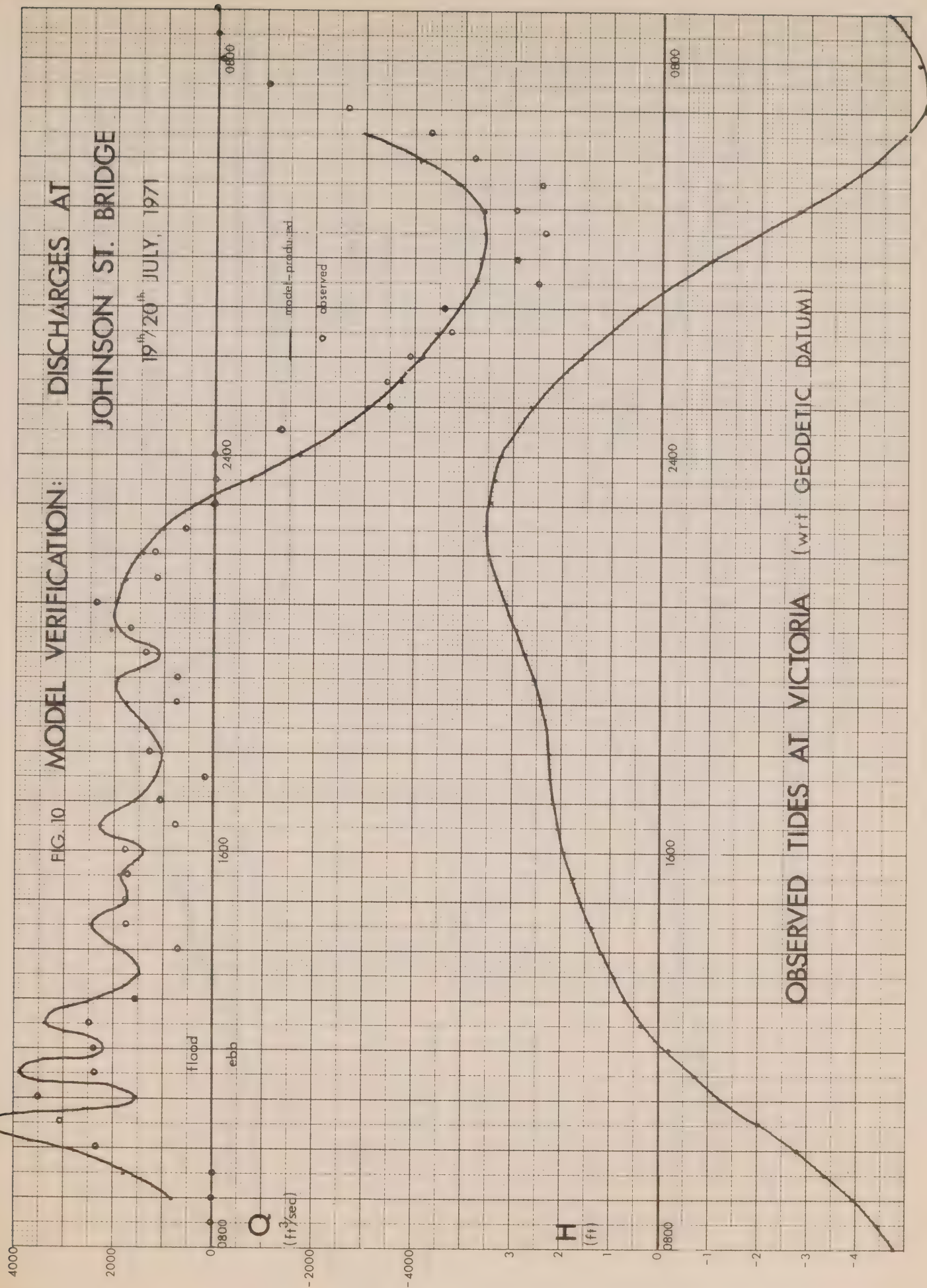
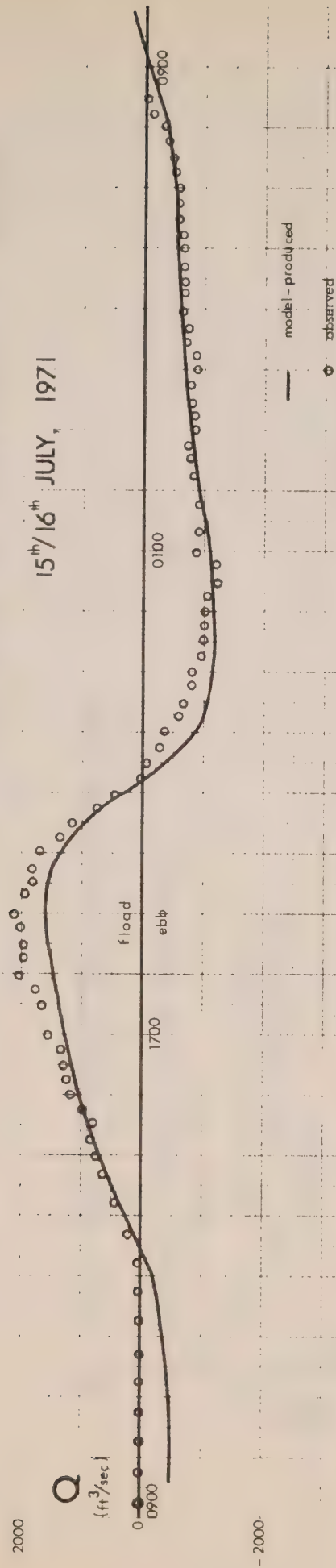


FIG. 11 MODEL VERIFICATION:

DISCHARGES AT CRAIGFLOWER BRIDGE

15th/16th JULY, 1971

-2000

-4000

3

2

1

H

(ft)

0

0900

-1

-2

-3

-4

OBSERVED TIDES AT CRAIGFLOWER BRIDGE

(wrt GEODETIC DATUM)

0100

1700

0900

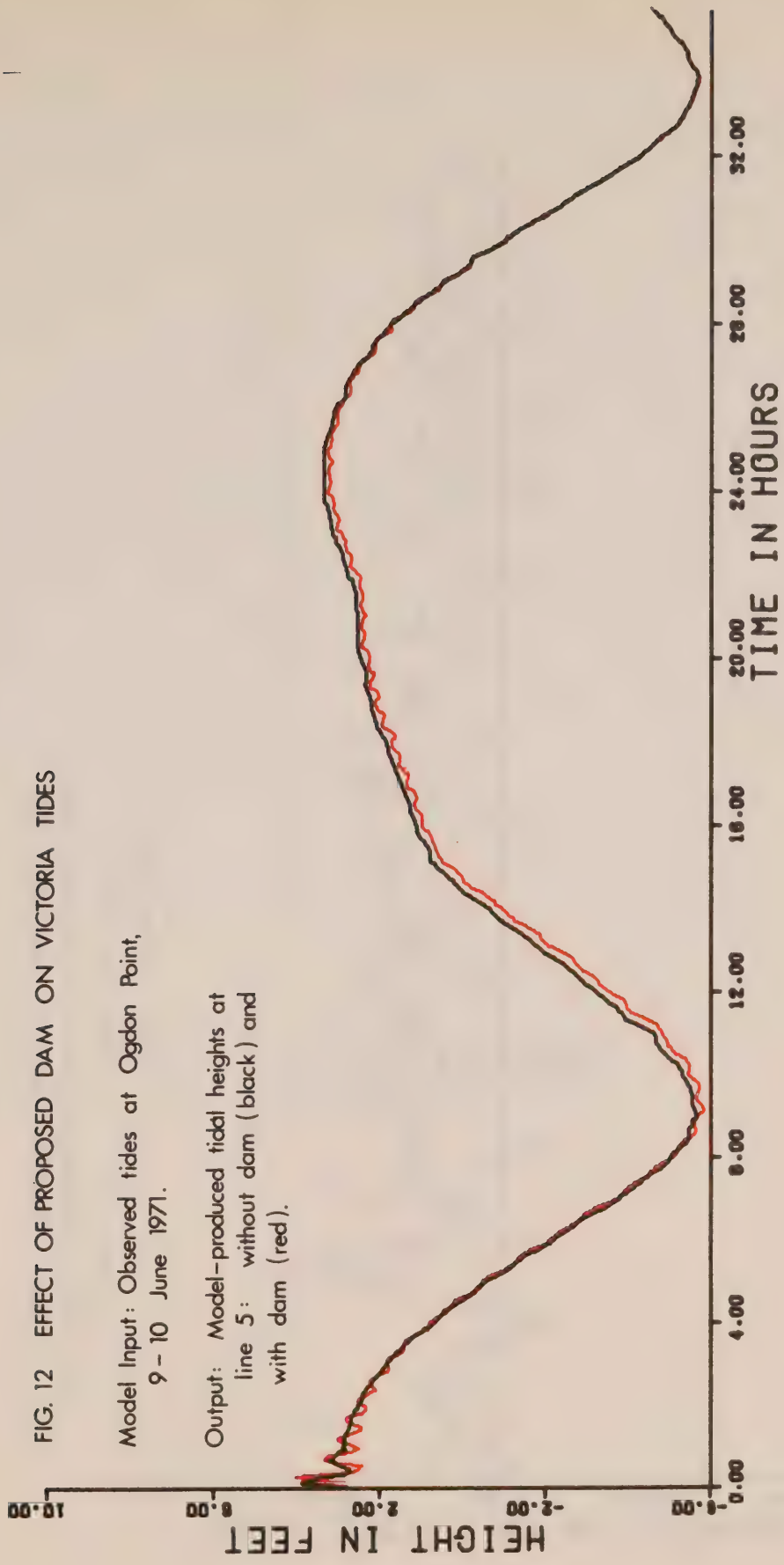


FIG. 12 EFFECT OF PROPOSED DAM ON VICTORIA TIDES

FIG. 13 EFFECT OF PROPOSED DAM ON TIDAL
CURRENTS AT JOHNSON ST. BRIDGE

Input: Observed tides at Ogden Pt., June 9-10, 1971
Output: Model-produced discharges at Johnson Street
Bridge.

Red: with dam

Black: without dam

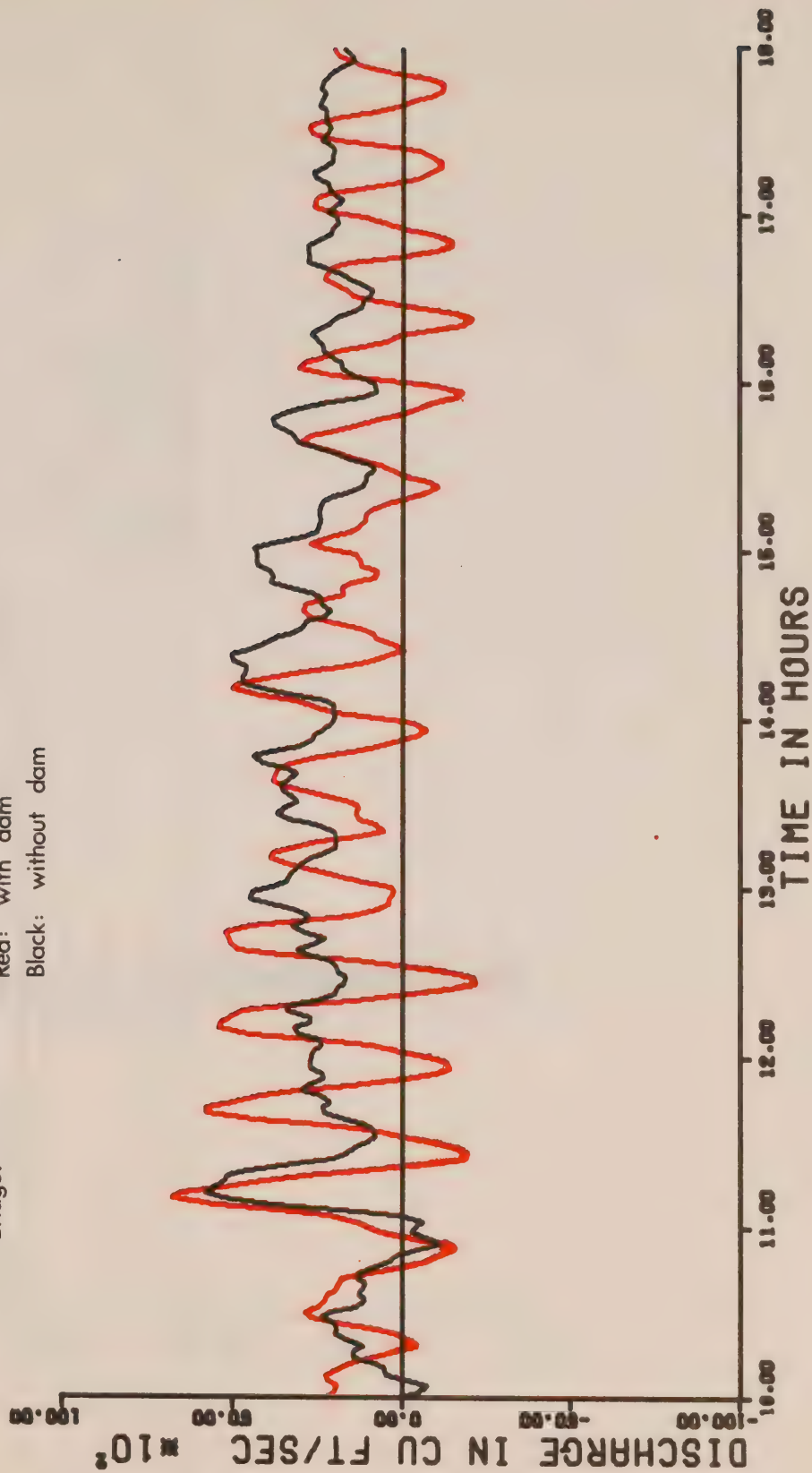


FIG. 14 EFFECT OF PROPOSED DAM ON TIDAL
CURRENTS AT JOHNSON ST. BRIDGE

Input at section line 1:

$$0-15 \text{ HRS: } H = 1.208 \cos \left(\frac{28.96}{3600} T + 84.9^\circ \right)$$

after 15 HRS: $H = 0$

Output at section line 6:

Discharge with dam - red

Discharge without dam - black

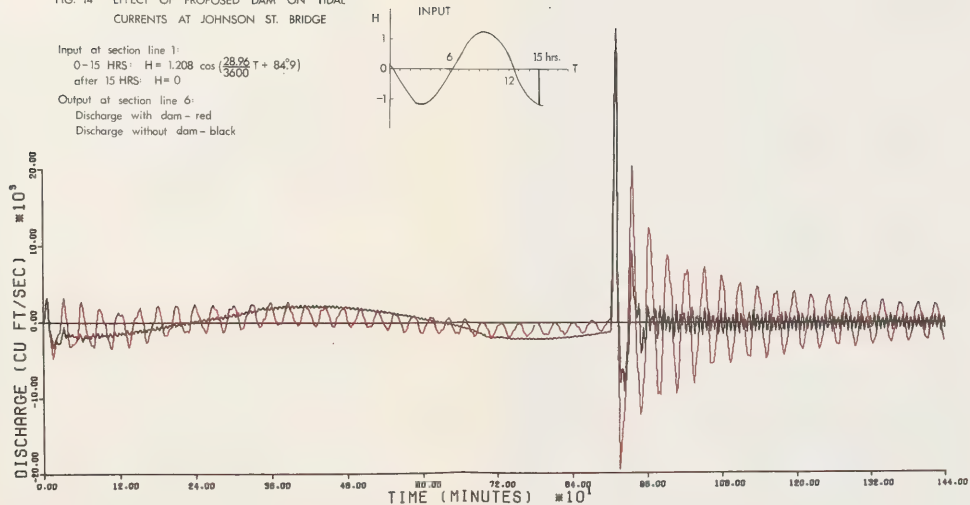


Fig. 15 Spectral analysis (Hanned FFT) of model-produced discharges at Johnson St. Bridge (Discreet time series of 2048 data at 40 second interval)

Input: Observed tidal heights at Ogden Point, June 9, 1971

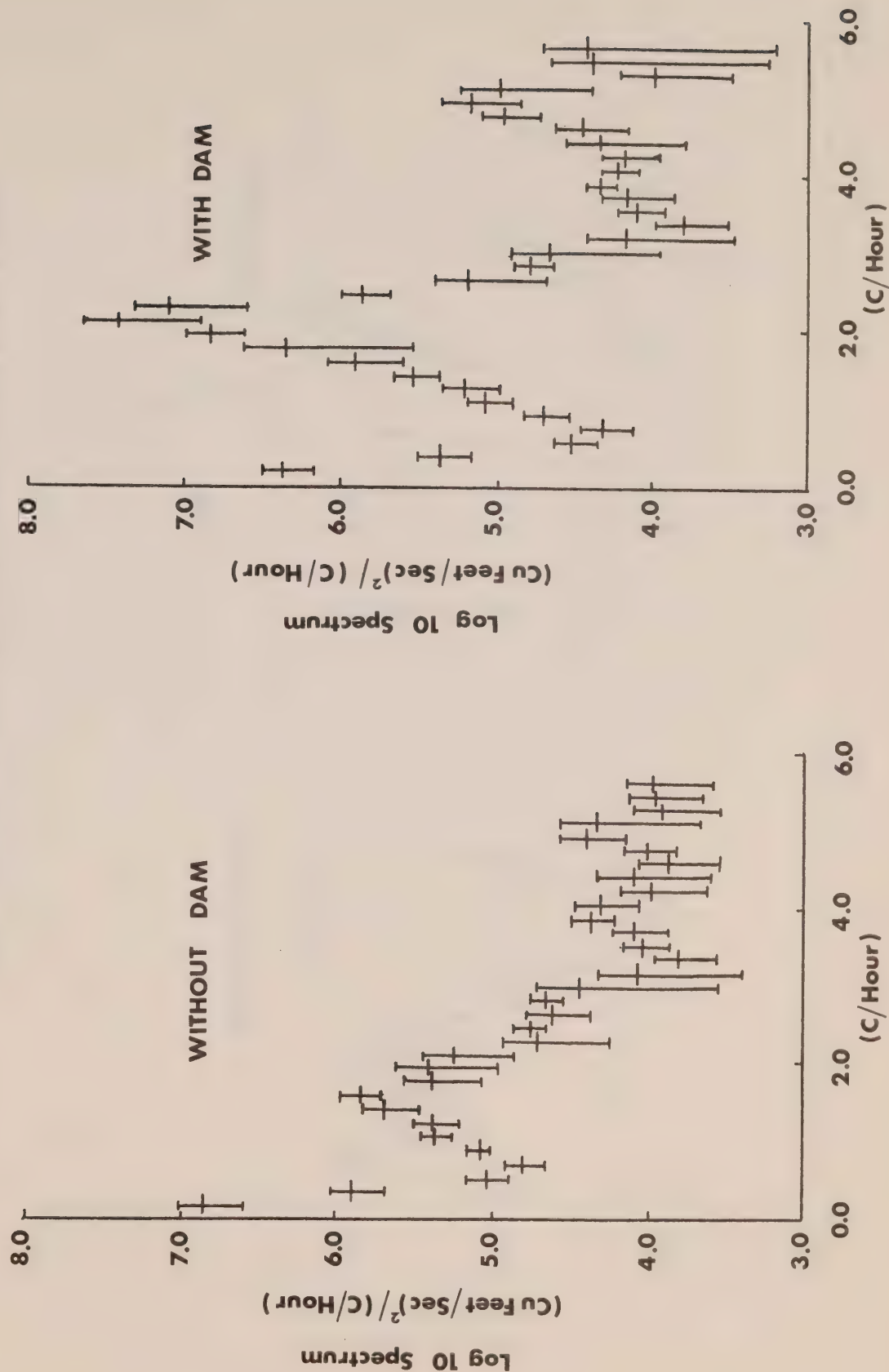


Fig. 16 Spectral analysis (Hanned FFT) of model-produced discharges at Johnson St. Bridge (Discreet time series of 2048 data at 40 second intervals)
Input: Observed tidal heights in Victoria harbour, March 3, 1968

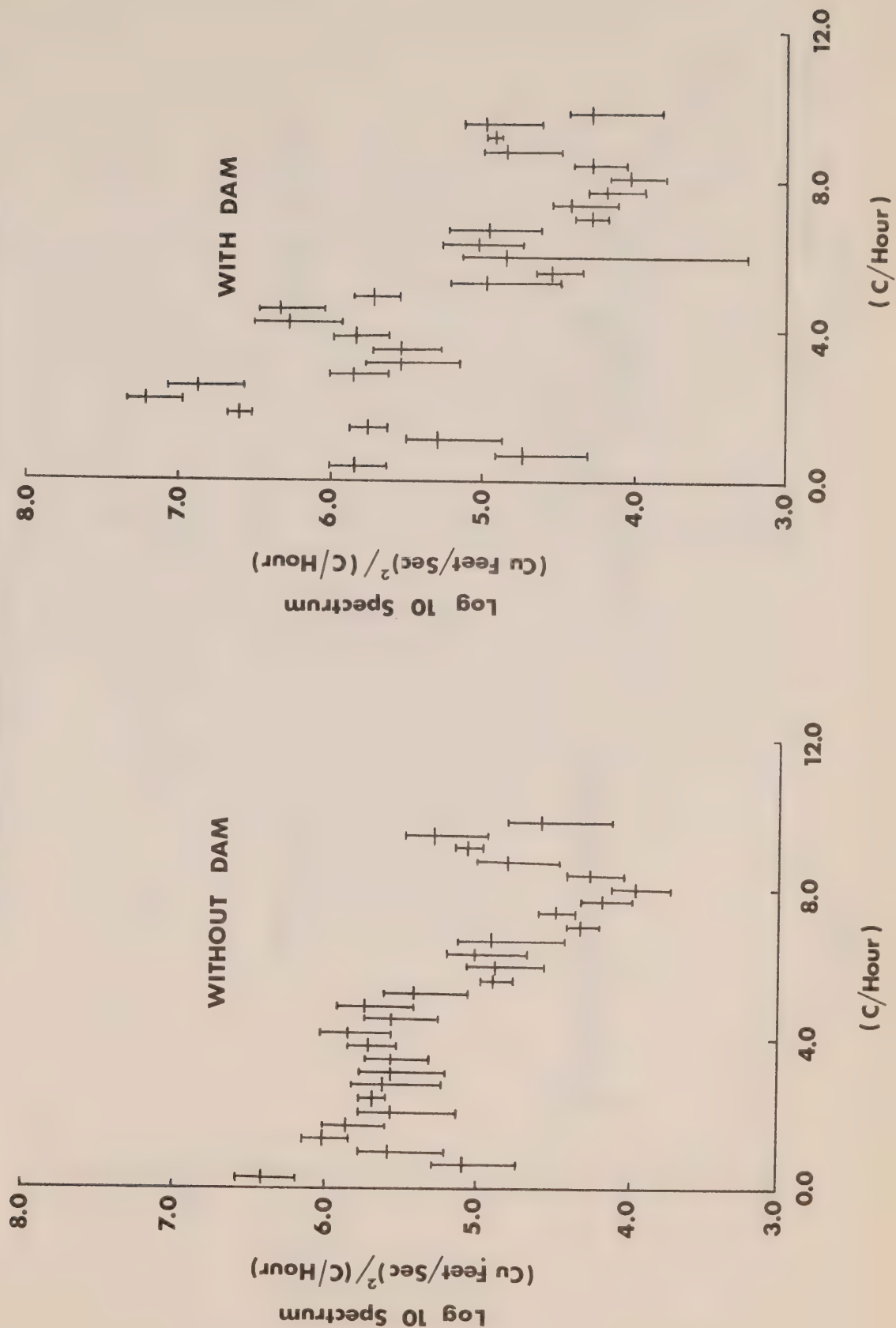
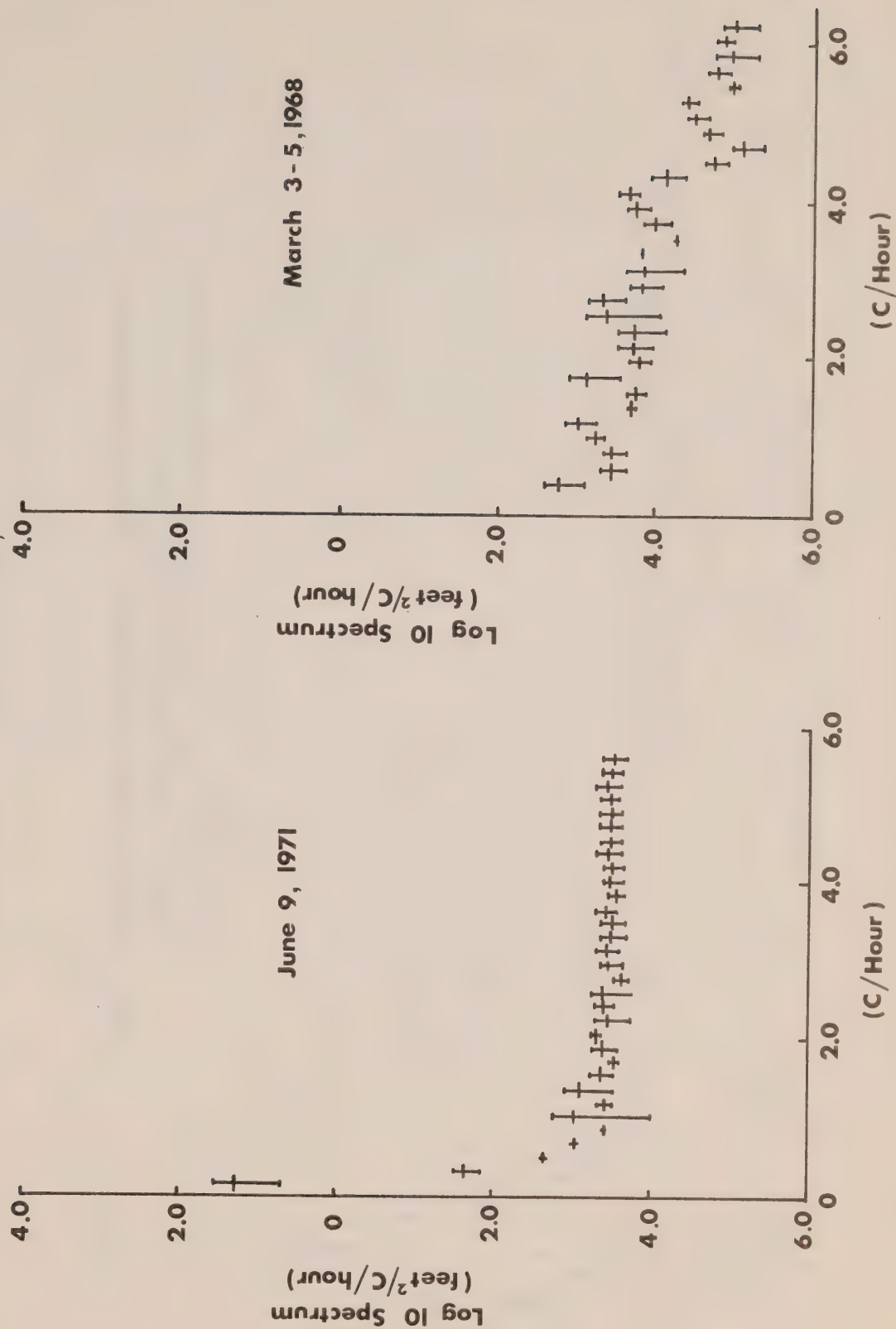


Fig. 17 Spectral analysis (Hanned FFT) of observed tidal heights in Victoria Harbour, June 9, 1971 (2048 data, 40 second intervals) and March 3-5, 1968 (1024 data, 3 minute intervals)



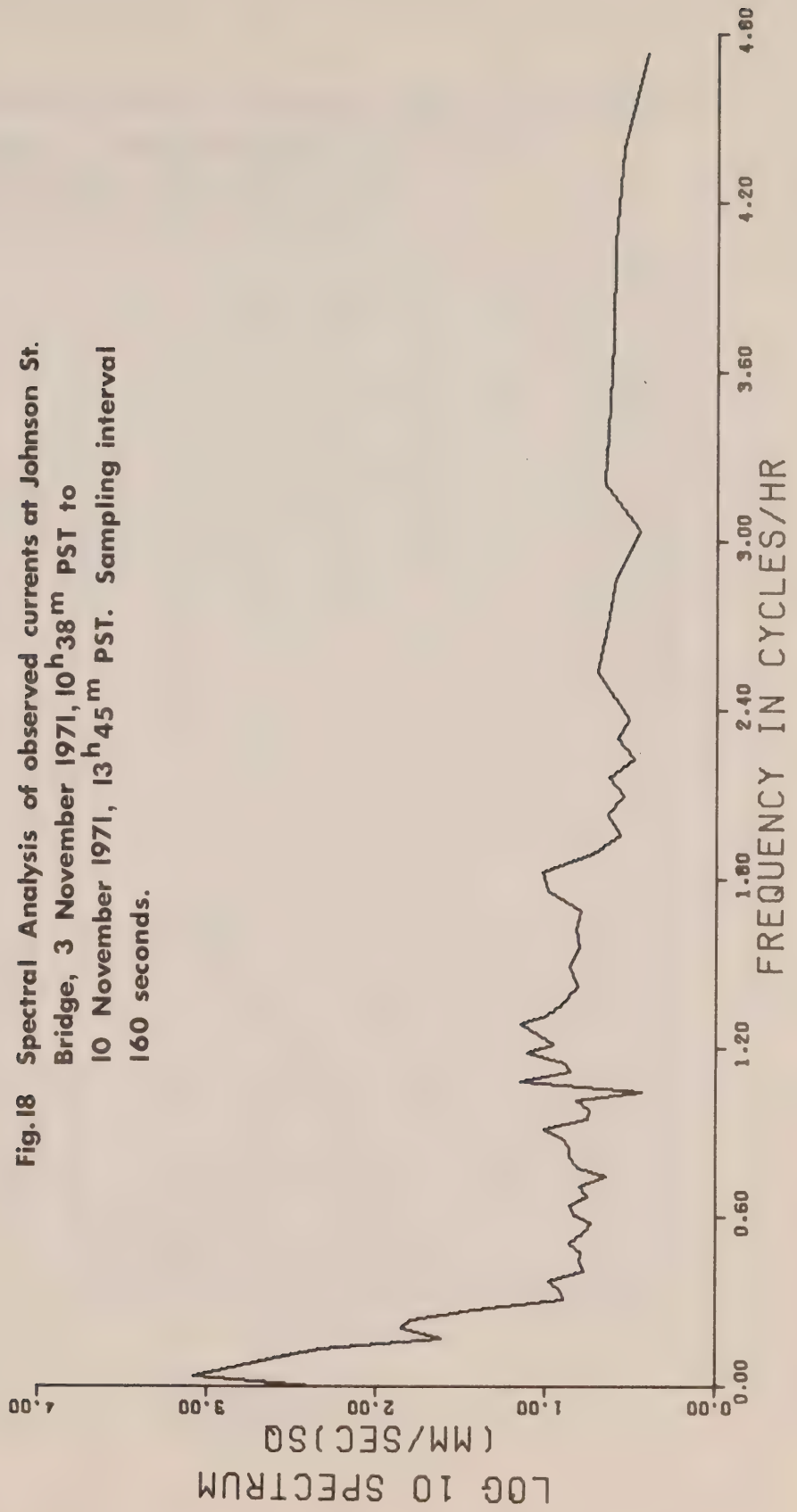


Fig. 18 Spectral Analysis of observed currents at Johnson St.
Bridge, 3 November 1971, 10^h38^m PST to
10 November 1971, 13^h45^m PST. Sampling interval
160 seconds.

Fig.19 Spectral Analysis of observed currents at Johnson St. Bridge, 3 November 1971, 11^h30^m PST to 10 November 1971, 09^h30^m PST.
Sampling interval 10 minutes

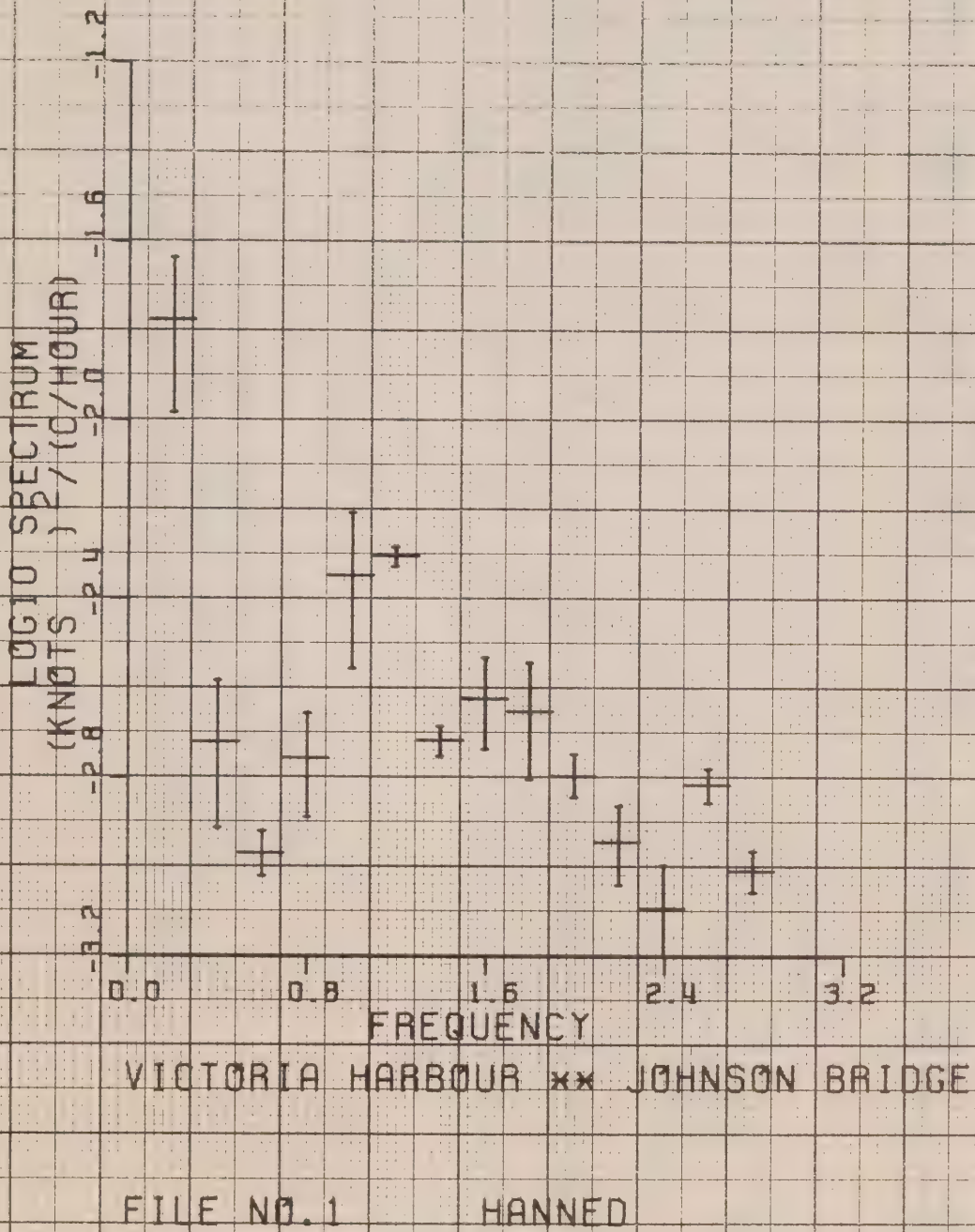


Fig.20 Proposed Portage Canal: Model-produced current velocities at Gorge (section 18) with canal (red), without canal (black); and in canal (green)
Input: M_2 tide.

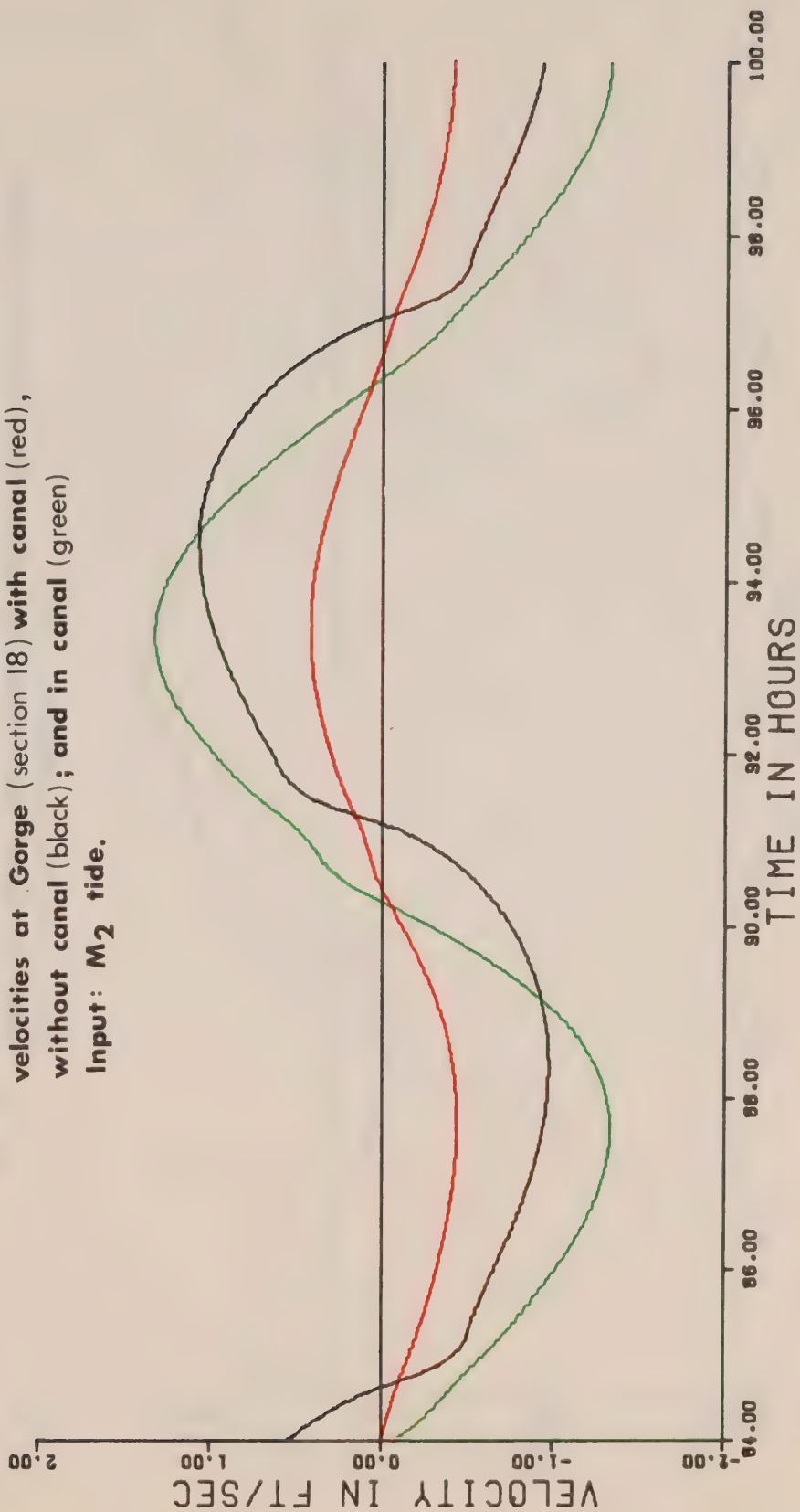
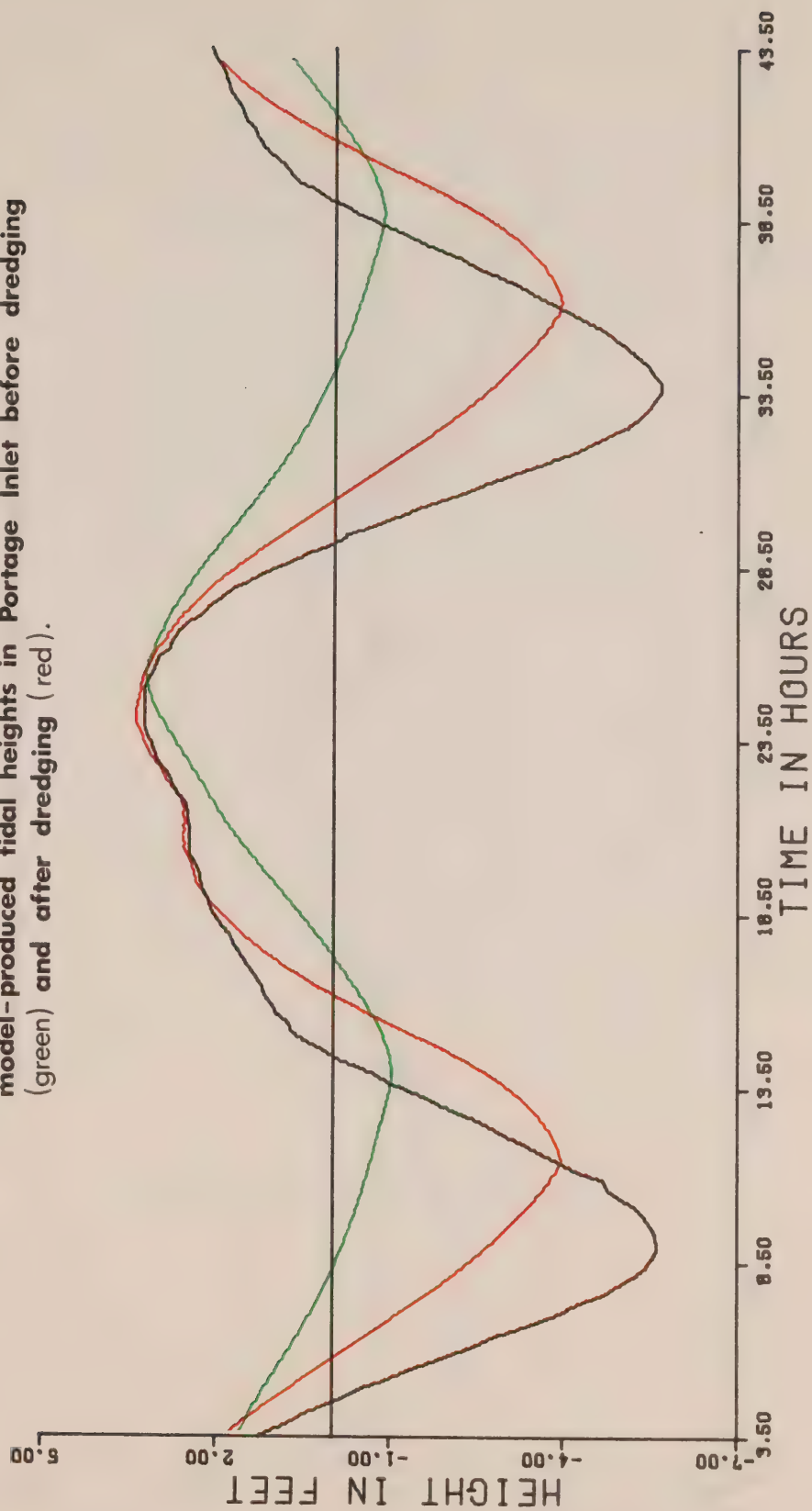
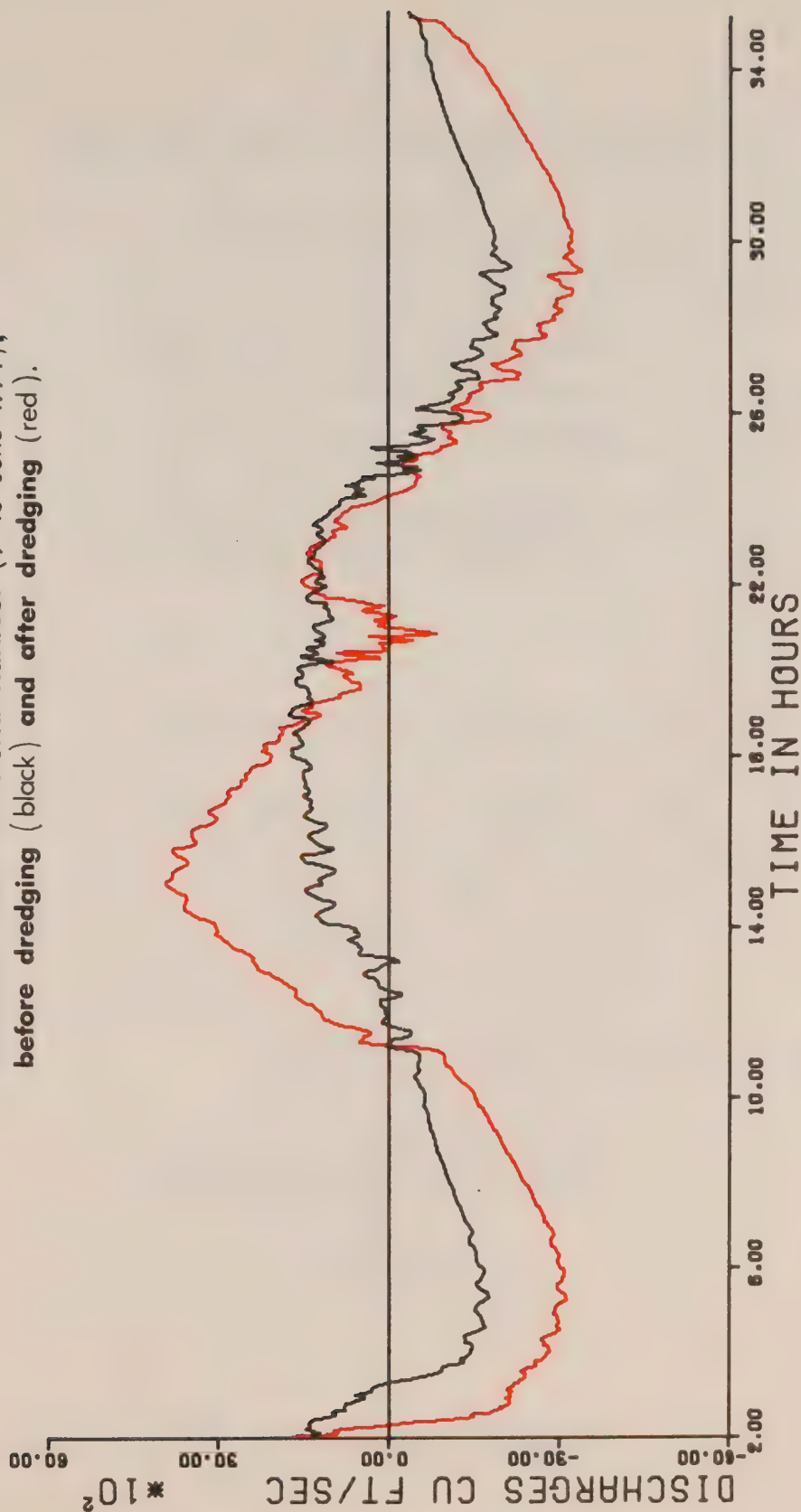


Fig. 21 Proposed dredging of the Gorge and Portage Inlet: Observed Victoria Harbour tidal heights (9-10 June 1971; in black); model-produced tidal heights in Portage Inlet before dredging (green) and after dredging (red).



**Fig. 22 Proposed dredging of the Gorge and Portage Inlet:
Model-produced discharges at Gorge Bridge due to
observed tides in Victoria Harbour (9-10 June 1971),
before dredging (black) and after dredging (red).**



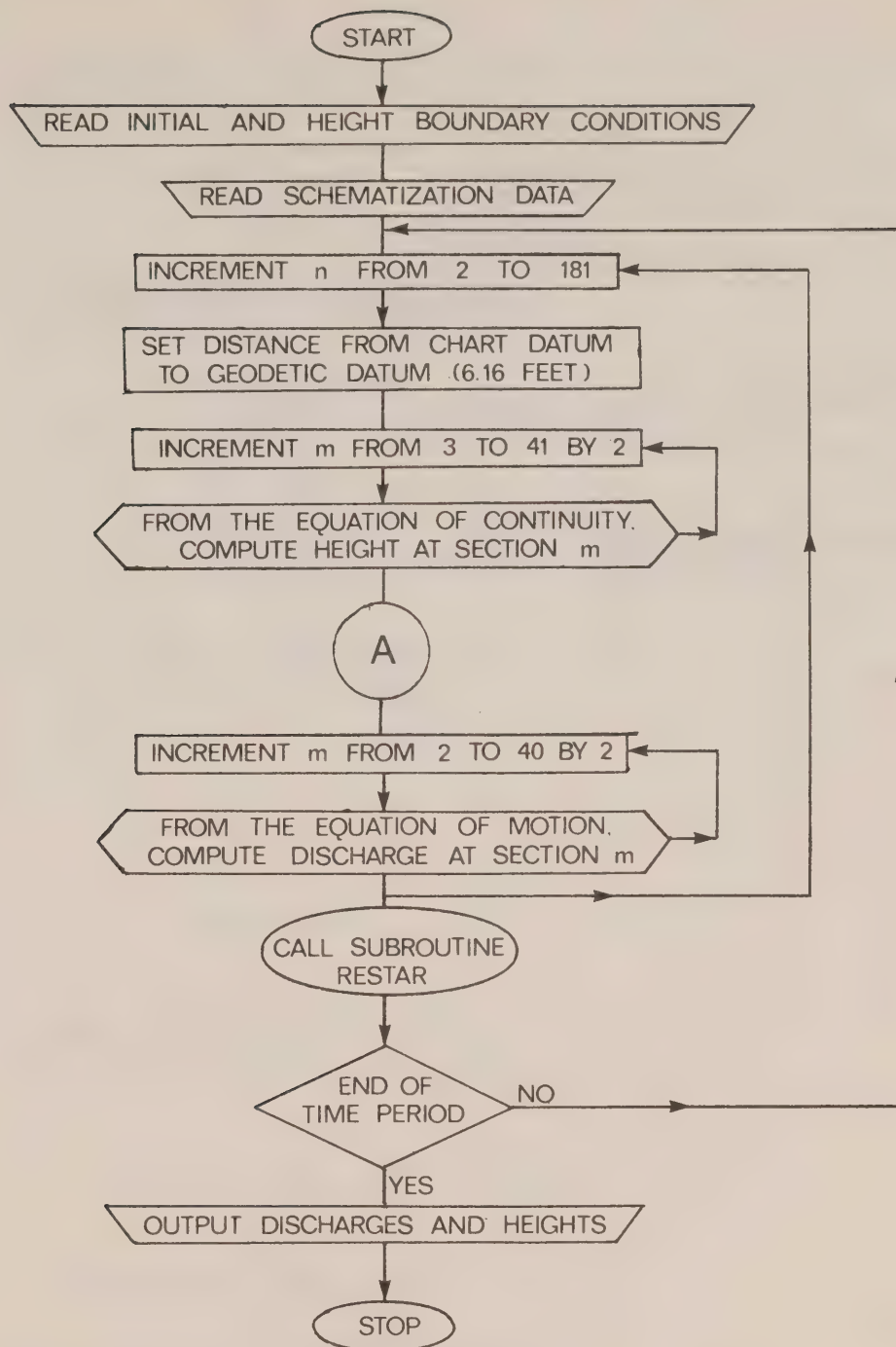


FIG. 23 FLOW CHART

**OCEANOGRAPHIC OBSERVATIONS AT
OCEAN STATION P (50°N , 145°W)**

Volume 55

Sept. 15, 1972 - Jan. 10, 1973

**C. de Jong, W. Hansen
Marine Sciences Directorate
Environment Canada**

and

**J.H. Linggard, Master, C.C.G.S. Vancouver
Marine Services Branch
Ministry of Transport**



**ENVIRONMENT CANADA
Fisheries and Marine Service
Marine Sciences Directorate
Pacific Region
1230 Government St.
Victoria, B.C.**

MARINE SCIENCES DIRECTORATE, PACIFIC REGION

PACIFIC MARINE SCIENCE REPORT 73-4

OCEANOGRAPHIC OBSERVATIONS AT OCEAN STATION P (50°N, 145°W)

VOLUME 55

SEPTEMBER 15, 1972 - JANUARY 10, 1973

by

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Environment Canada

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Marine Services Branch
Ministry of Transport

Victoria, B.C.
Marine Sciences Directorate, Pacific Region
Environment Canada
July, 1973

INTRODUCTION

Canadian operation of Ocean Weather Station P (latitude $50^{\circ}00'N$, longitude $145^{\circ}00'W$) was inaugurated in December, 1950. The station is occupied primarily to make meteorological observations of the surface and upper air and to provide an air-sea rescue service. The station is manned by two vessels operated by the Marine Services Branch of the Ministry of Transport. They are the CCGS VANCOUVER and the CCGS QUADRA. Each ship remains on station for a period of six weeks, and is then relieved by the alternative ship, thus maintaining a continuous watch.

Bathythermograph observations have been made at Station P since July, 1952. A programme of more extensive oceanographic observations was commenced in August, 1956. This was further extended in April, 1959, by the addition of a series of oceanographic stations along the route to and from Station P and Swiftsure Bank. These stations are known as Line P stations. The number of stations on Line P has been increased twice and now consists of twelve stations (Fig. 1). Bathythermograph observations and surface salinity sample collections in addition to being made on Line P oceanographic stations are also made at odd meridians at $40'$ i.e. $139^{\circ}40'W$, $141^{\circ}40'W$, etc. These stations are known as Line P BT stations. Data observed prior to 1968 has been indexed by Collins et al, (1969).

The present record includes hydrographic and salinity-temperature-pressure data collected from the QUADRA during the period September 15 to November 1, 1972, Line P surface temperature data from the VANCOUVER during the period October 27 to December 6, 1972, and hydrographic and salinity-temperature-pressure data collected from the QUADRA during the period December 1, 1972 to January 10, 1973.

All physical data have been archived by the Canadian Oceanographic Data Centre (CODC), 615 Booth Street, Ottawa, Ontario, Canada. Requests for these data should be directed to CODC.

Biological and productivity data are published in the Manuscript Report series of the Fisheries Research Board of Canada (FRB), the Biological Station, Nanaimo, B.C., Canada. Requests for these data should be directed to FRB.

Marine Geochemical data are for the Ocean Chemistry Group, Marine Sciences Directorate, Department of the Environment, 512-1230 Government St., Victoria, B.C., Canada.

Bird observations are sent to Dr. M. Myres, University of Calgary, Calgary, Alberta, Canada; and Marine Mammal observations to Mr. I. McAskie, Fisheries Research Board of Canada, The Biological Station, Nanaimo, B.C., Canada.

Programme of Observations from CCGS QUADRA, September 15 to November 1, 1972
(P-72-7) (CODC Ref. No. 15-72-007)

Oceanographic observations were made by Mr. C. de Jong, Marine Sciences Directorate, Department of the Environment.

En route to Station P, Stations 1 to 7 were occupied and STD casts made to near bottom or 1500 meters. Stations 8 to 12 were cancelled due to bad weather. Mechanical or XBT casts were made at all hydro and BT stations on line P and the surface temperature recorder was run continuously.

At Station P the oceanographic programme was carried out as follows:

I) Physical Oceanography

Profiles of salinity, temperature and oxygen were obtained as follows:

- 1) Weekly bottle casts to near bottom (4200 meters).
- 2) STD casts to 1500 meters following the bottle casts.
- 3) A total of 7 STD casts to 300 meters between weekly bottle stations.
- 4) Mechanical BT casts 8 times daily.
- 5) Surface salinity sample daily at 0000 hrs. GMT.
- 6) The wave recorder was run every 3 hours for 20 minutes to coincide with the daily meteorological observations.

II) Biological and Productivity

These data were collected as follows:

- 1) Plankton
A total of 6-50 meter, 6-150 meter, and 1-1200 meter vertical plankton hauls.
- 2) Two profiles for plant pigment and C-14 productivity.
- 3) Weekly secchi disk depth measurements.
- 4) No salmon but a few hundred pomfret were caught in the fishing programme. A few boar and skill fish were also taken with 2 skill fish delivered alive to the Vancouver Aquarium.

III) Marine Geochemistry

Samples for marine geochemical studies were obtained as follows:

- 1) Oxygen - at standard depths from the bottle stations.
- 2) Nutrient, phosphate and salinity samples daily at 0000 hrs. GMT plus hourly sampling for one 24 hour period from the ship's seawater loop.
- 3) Alkalinity samples every 3 days from the seawater loop.

IV) Marine Mammal, Bird and Data Gathered for Other Institutes

- 1) Marine mammal and bird observations were recorded.
- 2) Rainwater and sea surface water samples were collected for Scripps Institution of Oceanography.
- 3) A buoy mounted wave recorder ("waverider") was launched 6 times for calibration with the ship's wave recorder for Mr. G. Holland, Marine Sciences Directorate, Ottawa, Ontario.

En route from Station P, Station 12 was occupied and a STD cast to 1500 meters was made. The rest of the Line P programme was cancelled due to bad weather with the exception of the running of the continuous temperature recorder.

Programme of Observations from CCGS VANCOUVER, October 27 to December 6, 1972 (P-72-8) (CODC Ref. No. 15-72-008)

Oceanographic observations were made by the ship's officers. En route to Station P 8 XBT casts were made and the surface temperature recorder was run continuously.

At Station P the oceanographic programme was carried out as follows:

I) Physical Oceanography

- 1) Mechanical BT casts 8 times daily.
- 2) The wave recorder was run for approximately 20 minutes every 3 hours to coincide with the meteorological observations.

II) Marine Mammal, Bird and Data Gathered for Other Institutes

- 1) Marine mammal and bird observations were recorded.

En route from Station P the surface temperature recorder was run continuously.

Programme of Observations from CCGS QUADRA, December 1, 1972 to January 10, 1973 (P-72-9) (CODC Ref. No. 15-72-009)

Oceanographic observations were made by Mr. W. Hansen, Marine Sciences Directorate, Department of the Environment.

En route to Station P, Stations 2, 3, 4, 5, 6, 7, and 12 were occupied and STD casts to near bottom or 1500 meters were made. BT casts were made and surface salinity and nitrate samples were collected on Line P stations and the surface temperature recorder was run continuously.

At Station P the oceanographic programme was carried out as follows:

I) Physical Oceanography

- 1) A total of 4 bottle casts to near bottom (4200 meters).
- 2) A total of 7-1500 meter and 2-300 meter STD casts.
- 3) Mechanical BT casts 8 times daily.
- 4) Surface salinity sample daily at 0000 hrs. GMT.

II) Biological and Productivity

These data were collected as follows:

- 1) Plankton
A total of 4-150 meter, 2-1200 meter vertical hauls and 9-10 minute horizontal tows. Micro-organisms were sampled daily from the ship's seawater loop.
- 2) Three profiles for pigment, nitrate and C^{14} productivity plus one surface sample.
- 3) Weekly secchi disk depth measurements.

III) Marine Geochemistry

Samples for marine geochemical studies were obtained as follows:

- 1) Oxygen - at standard depths from the bottle stations.
- 2) Nutrient samples daily plus hourly sampling for one period of 24 hours from the seawater loop.
- 3) Alkalinity samples every 3 days from the seawater loop.
- 4) One $C^{14}O_2$ sample from the seawater loop.
- 5) Weekly air CO_2 samples.

IV) Marine Mammal, Bird and Data Gathered for Other Institutes

- 1) Marine mammal and bird observations were recorded.
- 2) Rainwater samples were collected for Scripps Institution of Oceanography, La Jolla, California, U.S.A.
- 3) The Scripps Institution of Oceanography's general dynamics instrumentation buoy was serviced and filmed.

En route from Station P, Stations 10 and 6 were occupied and STD casts to 1500 meters were made. Bad weather and boiler trouble prevented the occupation of the rest of the Line P stations. XBT casts were made and surface salinity and nitrate samples collected at all Line P stations plus a total of 14 surface samples for I.O.U.B.C.

Please note due to lack of O_2 standard O_2 samples were not processed until after the ship returned to port on cruise P-72-9.

Data was processed by Messrs. C. de Jong, W. Hansen, B. Minkley, D. Smith, and E. Luscombe, and assembled and edited for publication by Mr. K. Abbott-Smith.

Observational Procedures

Temperatures at depth were measured by deep-sea reversing thermometers of German (Richter and Wiese) or Japanese (Yoshino Keiki Co.) manufacture. Two protected thermometers were used on all Nansen bottles, and one unprotected thermometer was used on each bottle at depths of 300 m or greater. The accuracy of protected reversing thermometers is believed to be $\pm 0.02^\circ\text{C}$.

Surface water temperatures were measured from a bucket sample using a deck thermometer of $\pm 0.1^\circ\text{C}$ accuracy.

Salinity determinations were made aboard ship with either an Auto-Lab Model 601 Mark III inductive salinometer or a Hytech Model 6220 lab salinometer. Accuracy using duplicate determinations is estimated to be ± 0.003 ppt.

Depth determinations were made using the "depth difference" method described in the U.S.N. Hydrographic Office Publication No. 607 (1955). Depth estimates have an approximate accuracy of ± 5 m for depths less than 1000 m, and $\pm 0.5\%$ of depth for depths greater than 1000 m.

The dissolved oxygen analyses were done in the shipboard laboratory by a modified Winkler method (Carpenter, 1965).

Line P engine intake continuous temperatures on both ships were recorded by a Honeywell Model 15303836 Recorder. The temperature probe is at a depth of approximately 3 meters below the sea surface and the instrument accuracy is believed to be $\pm .1^\circ\text{C}$.

CCGS QUADRA is equipped with a Bissett Berman Model 6600-T salinograph-thermograph which is used, on Line P, for continuous recording of surface temperatures and salinities from the ship's seawater loop. The temperature probe is mounted at the seawater loop intake (approximately 3 meters below the surface) and the salinity probe and recorder is situated in the dry lab. The accuracy of this instrument is believed to be $\pm .1^\circ\text{C}$ for temperature and $\pm .1$ ppt for salinity.

CCGS VANCOUVER and CCGS QUADRA were equipped with a Bissett-Berman Model 9006 STD. The range of the salinity sensors on Cruises P-72-7 and P-72-9 was 27-37 ppt.

Computations

All hydrographic data were processed with the aid of an IBM 360 computer. Reversing thermometer temperature corrections, thermometric depth calculations, and accepted depth from the "depth difference" method were computed. Extraneous thermometric depths caused by thermometer malfunctions are automatically edited and replaced. A Calcomp 565 Offline Plotter was used to plot temperature-salinity and temperature-oxygen diagrams, as well as plots of temperature, salinity and dissolved oxygen vs \log_{10} depth. These plots were used to check the data for errors.

Missing hydrographic data were obtained using a weighted parabolas interpolation method (Reiniger and Ross, 1968). These data are indicated with an asterisk in this data record.

Data values that we suspect but are included in this data record are indicated with a plus. These data have been removed from punch card and magnetic tape records.

Analog records from the salinity-temperature-pressure instrument have been machine digitized, then replotted using the Calcomp Plotter.

Digitization was continued until original and computer plotted traces were coincident. Temperature and salinity values were listed at standard pressures; integrals (depths, geopotential anomaly, and potential energy anomaly) were computed from the entire array of digitized data.

The headings for the data listings are explained as follows:

PRESS	is pressure (decibars)
TEMP	is temperature (degrees Celsius)
SAL	is salinity (parts per thousand)
DEPTH	is reported in meters
SIGMA-T	is specific gravity anomaly
SVA	is specific volume anomaly
THETA	is potential temperature (degrees Celsius)
SVA (THETA)	is potential specific volume anomaly
DELTA D	is geopotential anomaly (J/kg)
POT EN	is potential energy in units of 10^8 ergs/cm ²
OXY	is the concentration of dissolved oxygen expressed in milliliters per liter
B-V PERIOD	is the Brunt-Vaisala period in minutes

Summary of Hydrographic Data

The data are graphically summarized as follows:

Composite plots of temperature vs \log_{10} depth (Fig. 4, P-72-7) and (Fig. 12, P-72-9).

Composite plots of salinity vs \log_{10} depth (Fig. 5, P-72-7) and (Fig. 13, P-72-9).

Composite plots of oxygen vs \log_{10} depth (Fig. 6, P-72-7) and (Fig. 14, P-72-9).

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- Collins, C.A., R.L. Tripe, D.A. Healey, and J. Joergensen. 1969. The Time Distribution of Serial Oceanographic Data from the Ocean Station P Programme. *Fish. Res. Bd. Can. Tech. Rept.*, no. 106.
- Reiniger, R.F., and C.K. Ross. 1968. A Method of Interpolation with Application to Oceanographic Data. *Deep Sea Res.*, 15: 185-193.
- U.S.N. Hydrographic Office. 1955. Instruction Manual for Oceanographic Observations, Publ. no. 607.

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| Figure 6 | Temperature difference reversing thermometers - STD. P-72-7. |
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| Figure 8 | T-S plot of surface temperature and salinity observations on Line P (asterisks) and at Station P (pluses). P-72-7. |
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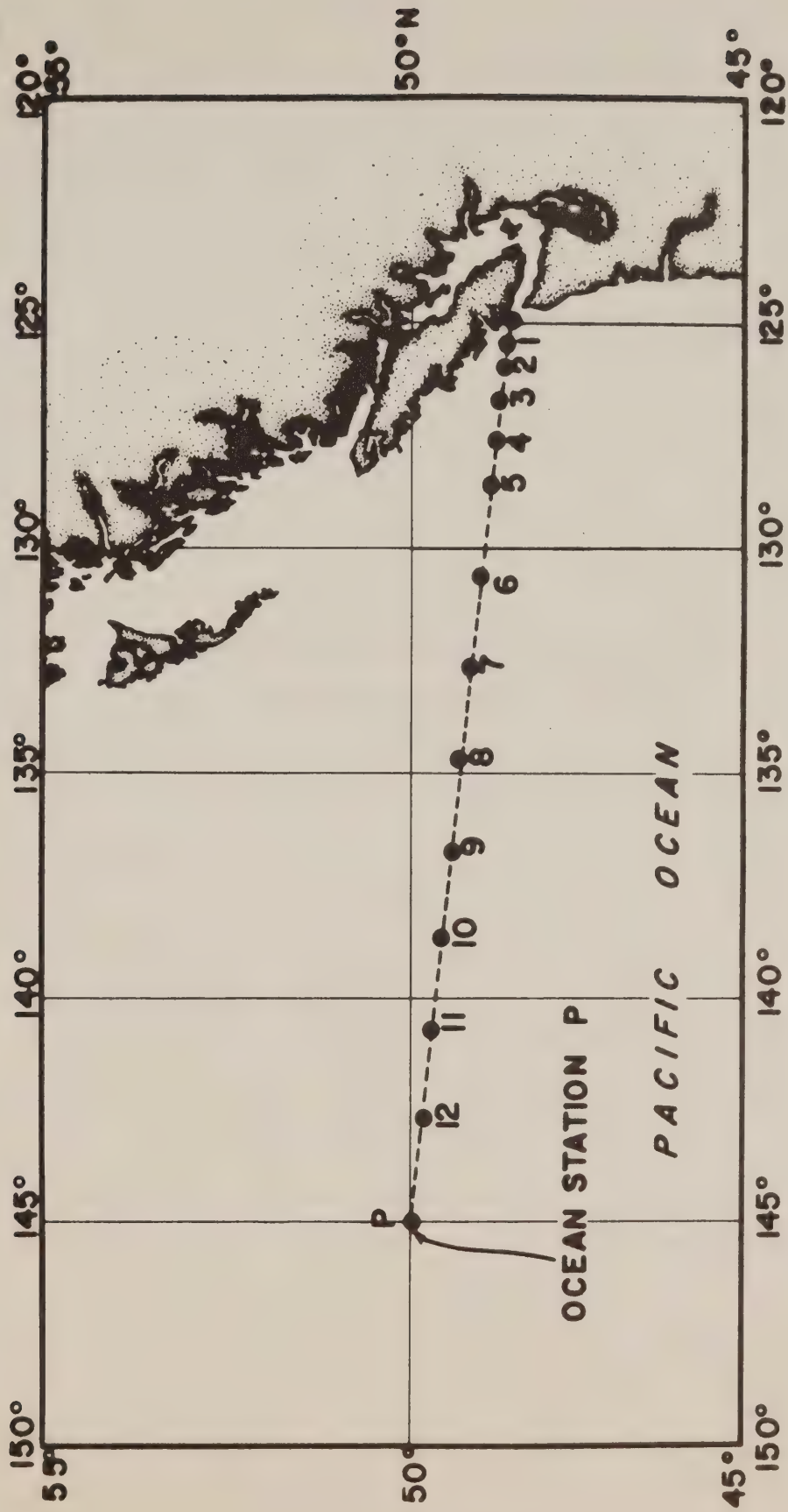


Fig. 1 Chart showing Line P station positions.

OCEANOGRAPHIC DATA OBTAINED ON CRUISE P-72-7
(CODC REFERENCE NO. 15-72-007)

RESULTS OF BOTTLE CASTS

(P-72-7)

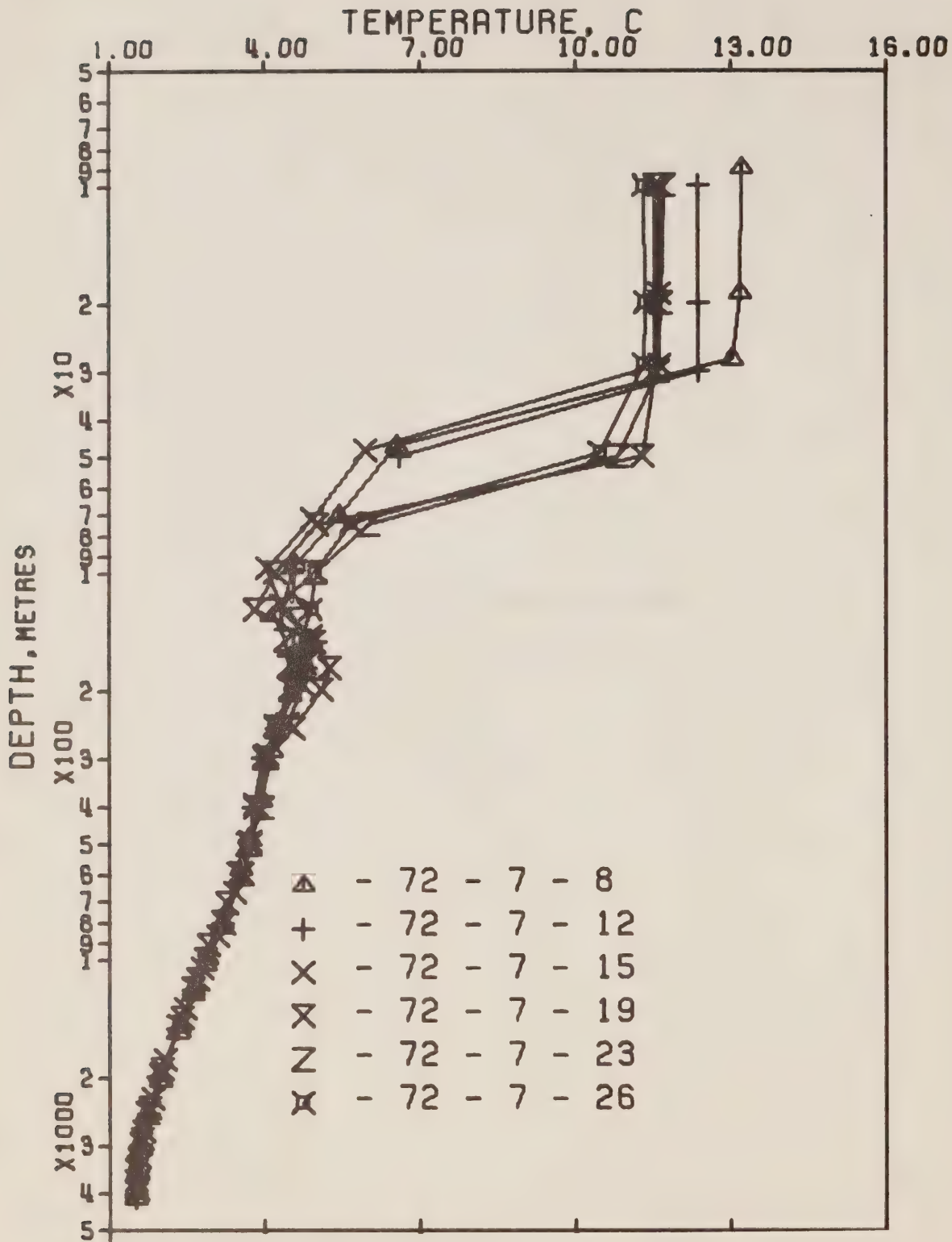


Figure 2 Composite plot of temperature vs \log_{10} depth. P-72-7.

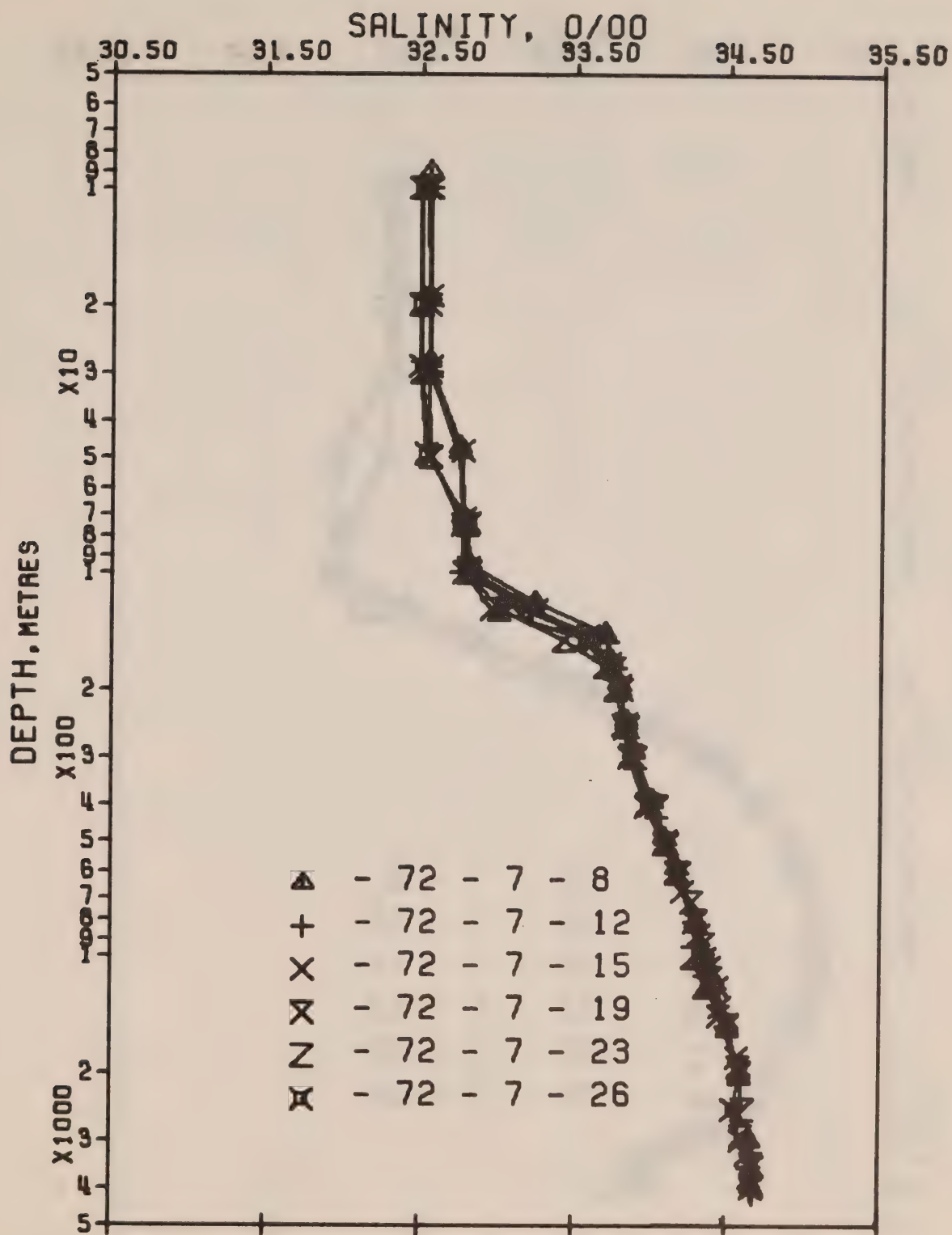


Figure 3 Composite plot of salinity vs \log_{10} depth. P-72-7.

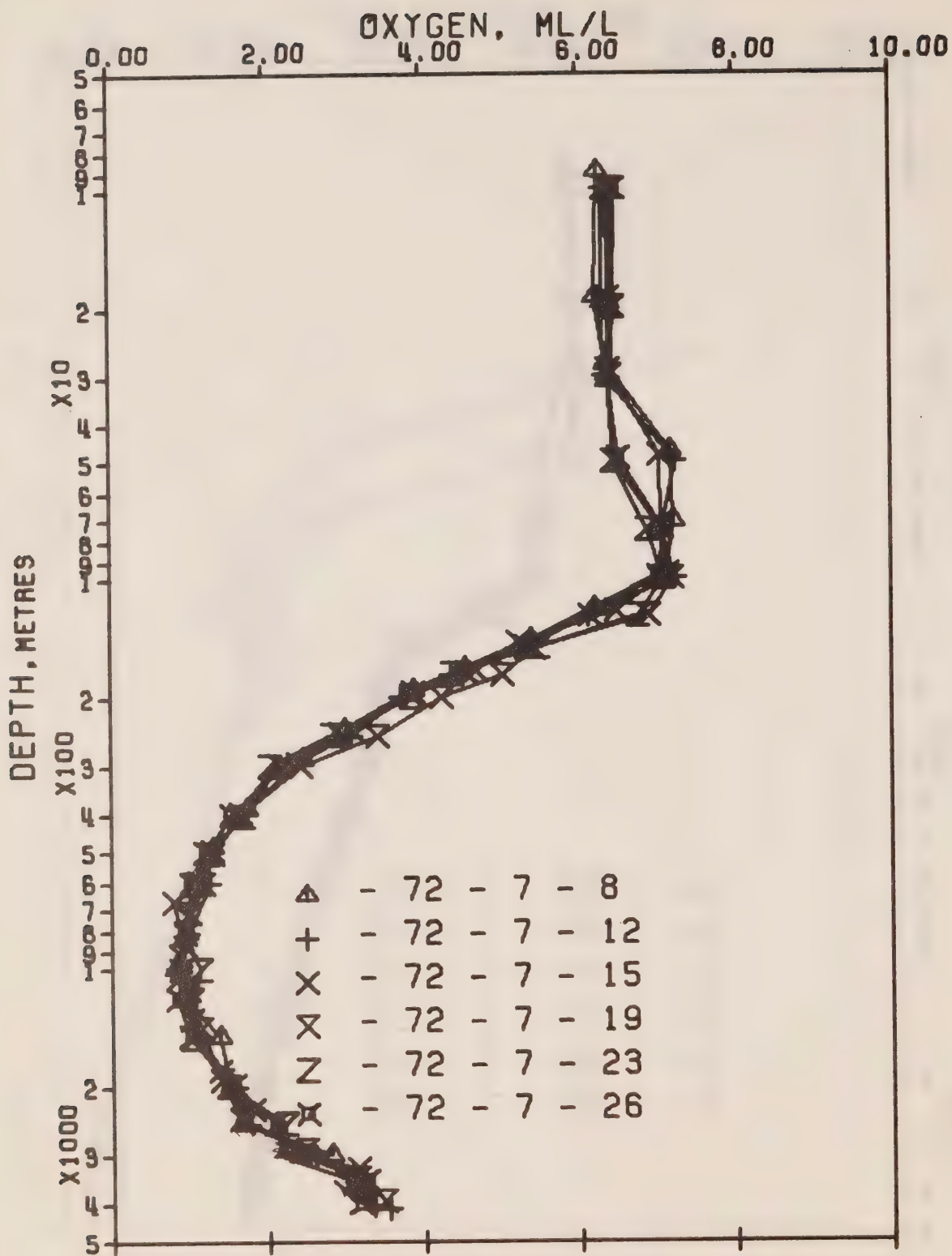
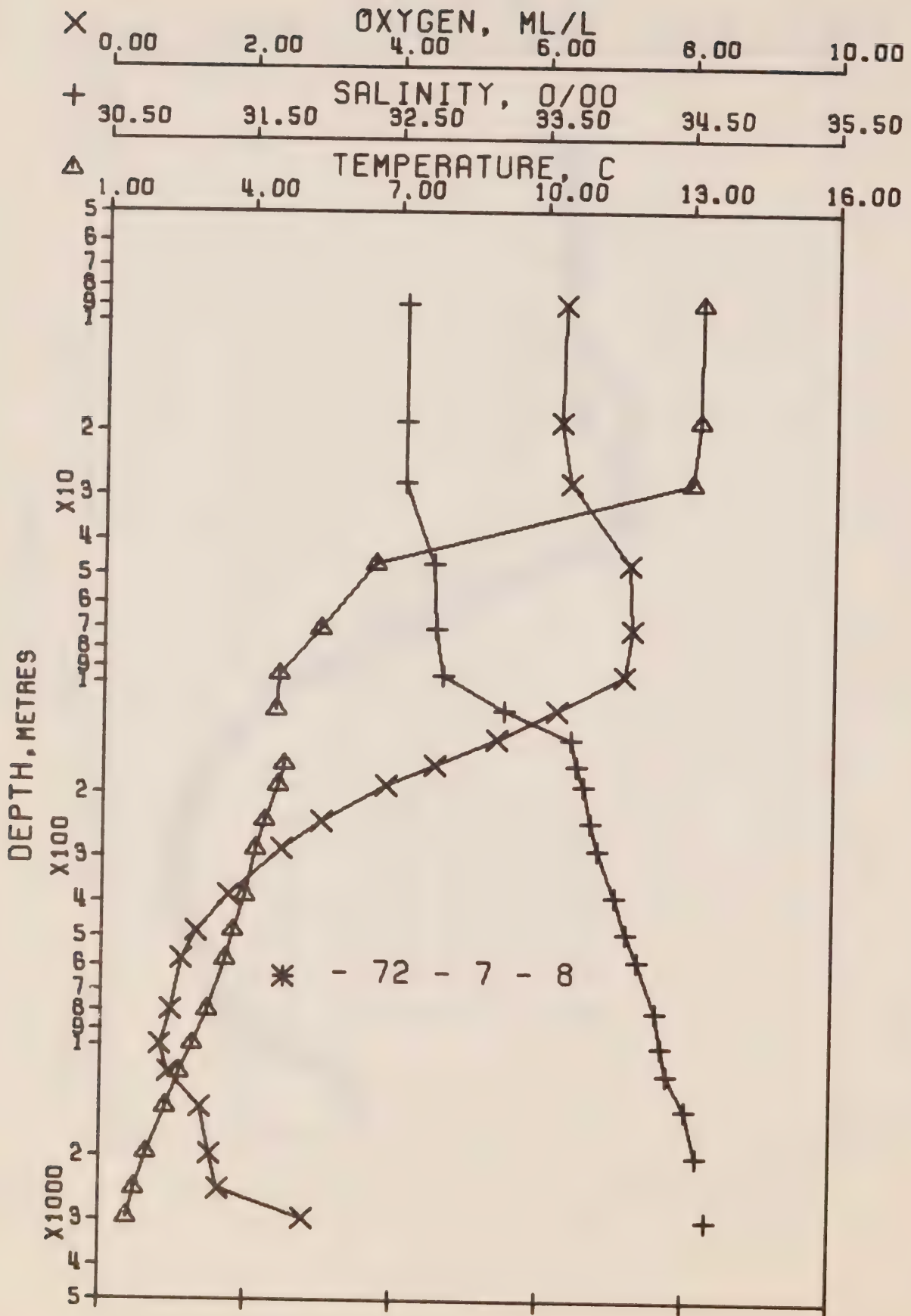


Figure 4 Composite plot of oxygen vs \log_{10} depth. P-72-7.



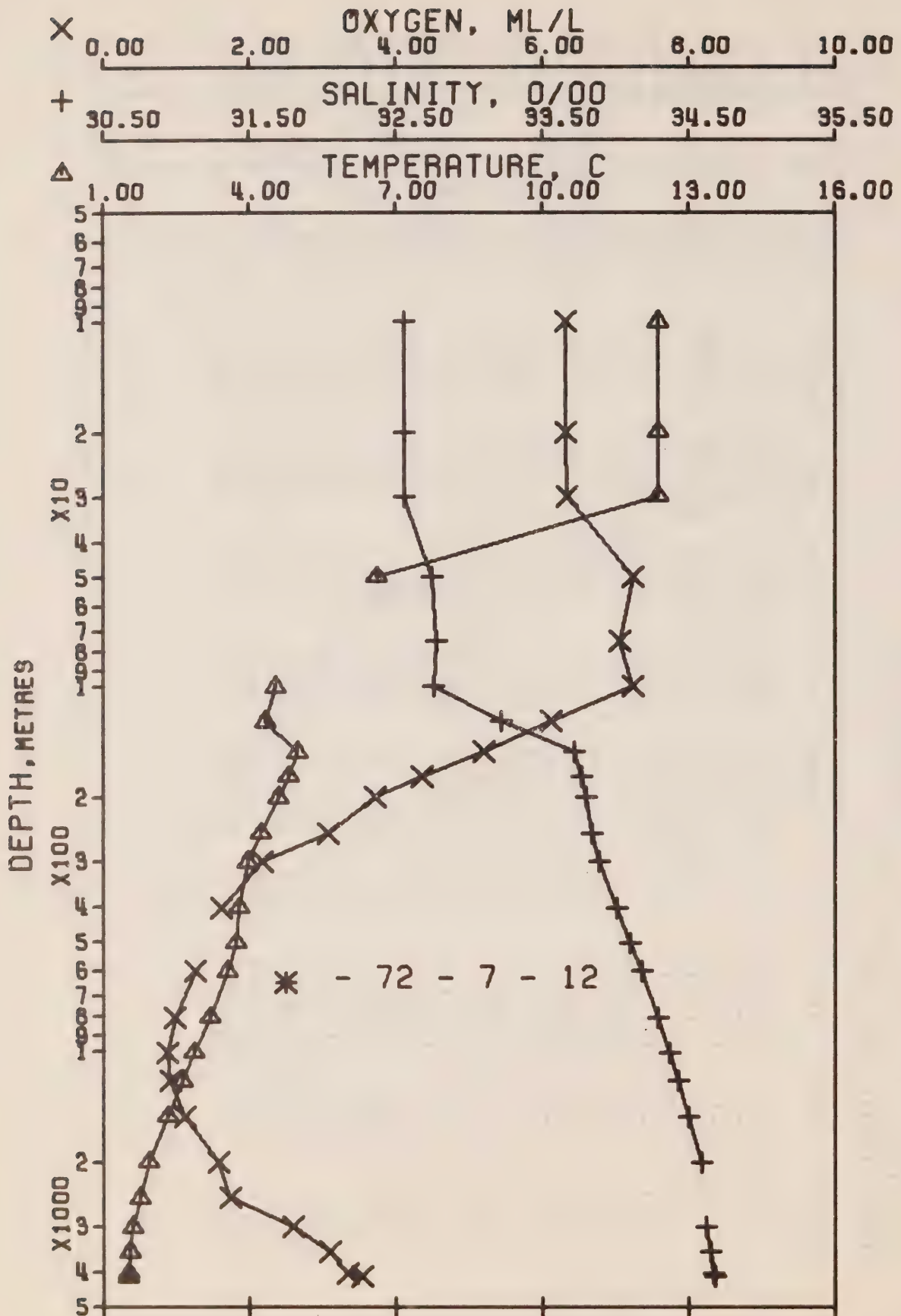
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 7- 8 DATE 19/ 9/72

POSITION 50- 0.0 N. 145- 0.0 W GMT 20.1

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	13.22	32.555	0	24.481	346.3	13.22	346.1	0.0	0.0	6.23	1499.
9	13.20	32.550	9	24.481	346.5	13.20	346.1	0.31	0.01	6.26	1499.
19	13.17	32.547	19	24.485	346.4	13.17	345.7	0.66	0.06	6.21	1499.
28	13.02	32.551	28	24.518	343.5	13.02	342.6	0.98	0.14	6.35	1498.
47	6.54	32.751	47	25.734	227.7	6.54	226.9	1.53	0.35	7.19	1475.
71	5.44	32.769	71	25.884	213.7	5.43	212.6	2.04	0.66	7.23	1471.
95	4.60	32.819	95	26.017	201.0	4.59	199.9	2.54	1.09	7.11	1468.
120	4.55	33.243	119	26.358	168.9	4.54	167.5	2.99	1.58	6.20	1459.
144	4.64*	33.701	143	26.711	135.7	4.63	134.0	3.36	2.07	5.38	1470.
169	4.71	33.742	168	26.736	133.7	4.70	131.6	3.69	2.61	4.53	1471.
193	4.60	33.790	192	26.786	129.1	4.59	126.9	4.01	3.20	3.89	1471.
243	4.33	33.841	241	26.855	122.9	4.31	120.3	4.63	4.57	3.00	1471.
291	4.16	33.894	289	26.915	117.5	4.14	114.5	5.21	6.16	2.47	1471.
390	3.94	34.015	387	27.034	106.9	3.91	103.2	6.32	10.00	1.73	1472.
489	3.69	34.091	485	27.120	99.5	3.66	95.1	7.34	14.57	1.30	1472.
587	3.55	34.174	582	27.199	92.5	3.51	87.5	8.28	19.72	1.09	1473.
808	3.18	34.301	801	27.336	80.7	3.12	74.5	10.18	33.23	0.97	1476.
1076	2.89	34.342	996	27.395	75.8	2.82	68.8	11.72	47.47	0.83	1478.
1204	2.62	34.385	1192	27.453	70.8	2.54	63.2	13.17	63.89	0.94	1480.
1504	2.35	34.509	1488	27.575	60.1	2.25	51.4	15.14	90.93	1.39	1484.
2012	1.97	34.591	1987	27.671	51.9	1.83	42.1	17.92	140.95	1.51	1431.
2524	1.73	34.623*	2490	27.715	48.4	1.55	37.7	20.47	200.00	1.64	1498.
3040	1.58	34.656	2996	27.753	45.7	1.35	33.9	22.90	268.74	2.81	1507.



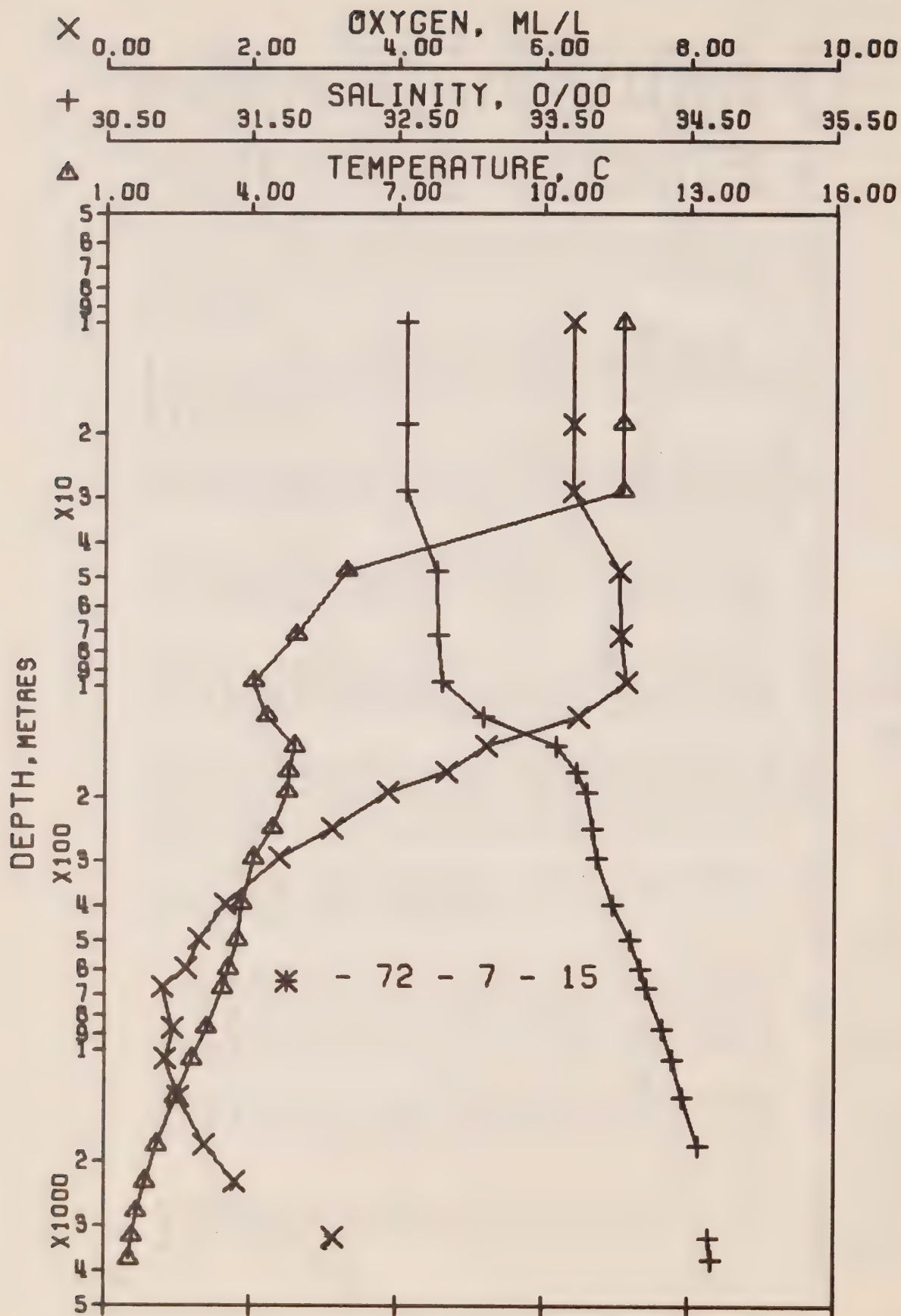
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 7- 12 DATE 25/ 9/72

POSITION 50- 0.0 N. 145- 0.0 W GMT 18.6

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. FN	OXY	SOUND
0	12.38	32.570	0	24.656	329.7	12.38	329.5	0.0	0.0	6.32	1496.
10	12.38	32.564	10	24.651	330.4	12.38	329.8	0.33	0.02	6.33	1496.
20	12.37	32.562	20	24.652	330.5	12.37	329.8	0.66	0.07	6.32	1496.
30	12.37	32.564	30	24.653	330.7	12.37	329.7	1.00	0.15	6.34	1496.
50	6.61	32.751	50	25.725	228.6	6.61	227.7	1.57	0.38	7.24	1475.
75	3.86*	32.784	75	26.065	196.2	3.85	195.4	2.08	0.71	7.06	1455.
101	4.55	32.757	100	25.973	205.2	4.54	204.1	2.59	1.17	7.24	1468.
126	4.32	33.219	125	26.363	168.4	4.31	167.1	3.06	1.72	6.12	1468.
152	5.00	33.723	151	26.688	138.1	4.99	136.1	3.46	2.28	5.20	1472.
177	4.81	33.770	176	26.747	132.7	4.80	130.6	3.80	2.85	4.35	1471.
202	4.61	33.803	201	26.795	128.3	4.59	126.0	4.13	3.48	3.71	1471.
254	4.23	33.836	252	26.862	122.3	4.21	119.7	4.77	4.98	3.08	1470.
304	3.98	33.890	302	26.931	116.1	3.96	113.1	5.37	6.69	2.18	1470.
406	3.80	34.009	403	27.043	106.0	3.77	102.3	6.50	10.77	1.62	1471.
507	3.72	34.100	503	27.124	99.2	3.68	94.6	7.53	15.59	0.0	1473.
608	3.56	34.176	603	27.200	92.6	3.52	87.4	8.50	21.09	1.27	1474.
814	3.19	34.294	807	27.329	81.4	3.13	75.0	10.29	34.04	0.98	1476.
1015	2.95	34.366	1005	27.417	73.6	2.78	66.6	11.83	48.47	0.87	1478.
1216	2.61	34.428	1204	27.488	67.6	2.53	59.8	13.25	64.61	0.92	1480.
1521	2.32	34.503	1504	27.572	60.4	2.22	51.7	15.19	91.66	1.13	1484.
2031	1.94	34.593	2006	27.675	51.4	1.80	41.8	18.01	142.57	1.59	1491.
2546	1.74	34.614*	2512	27.707	49.2	1.56	38.4	20.58	202.58	1.74	1499.
3064	1.59	34.617	3019	27.721	48.6	1.36	36.9	23.11	275.01	2.61	1507.
3582	1.53	34.651	3525	27.752	46.8	1.25	33.5	25.58	358.51	3.11	1516.
4098	1.52	34.670	4029	27.768	46.6	1.19	31.7	28.00	453.61	3.34	1524.
4201	1.52	34.635	4129	27.780	45.9	1.17	30.5	28.48	473.70	3.54	1526.



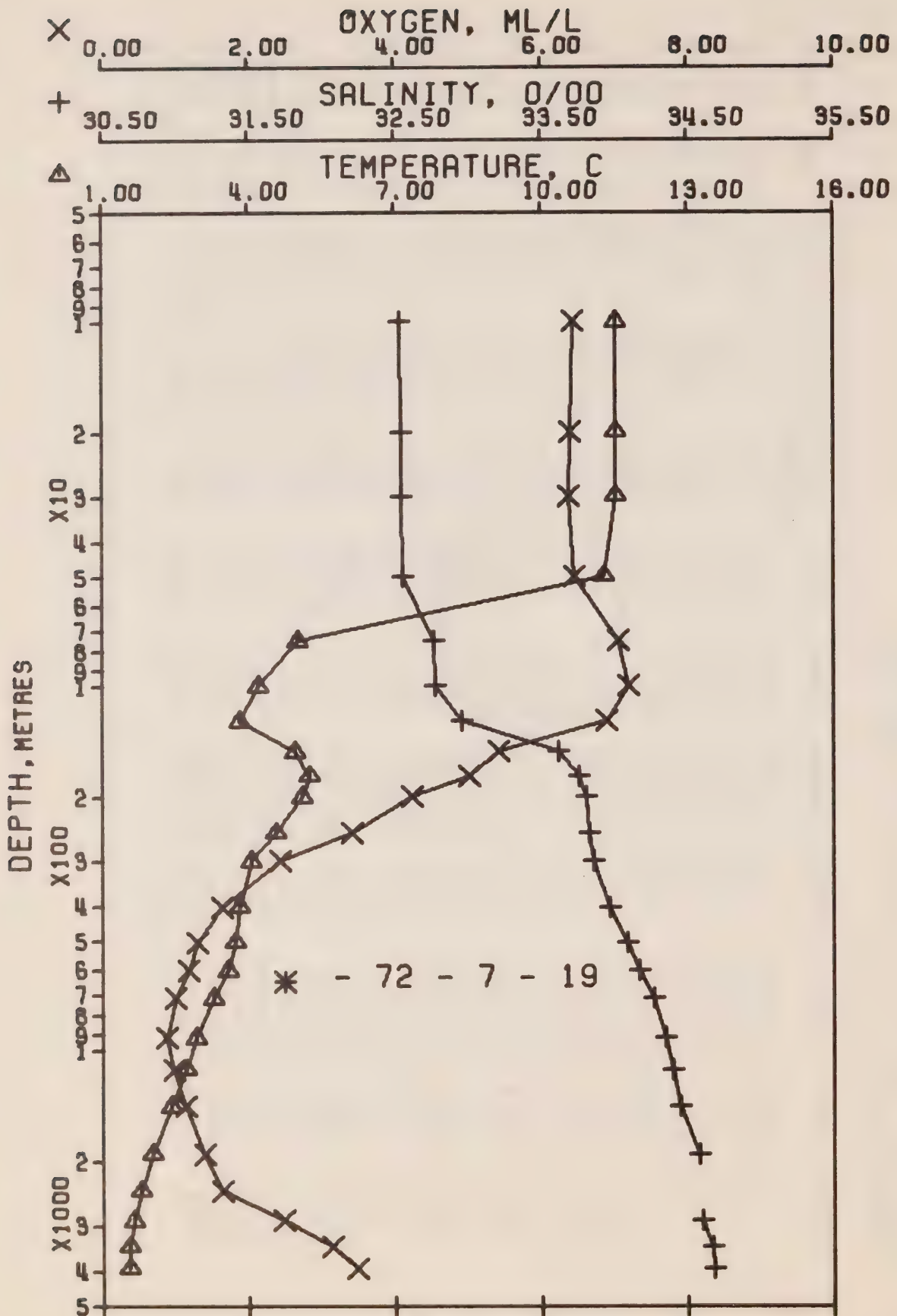
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 7- 15 DATE 3/10/72

POSITION 50- 0.0 N. 145- 0.0 W GMT 18.1

HYDROGRAPHIC CAST DATA

PRFSS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	11.66	32.560	0	24.783	317.6	11.66	317.4	0.0	0.0	6.46	1493.
10	11.62	32.561	10	24.791	317.0	11.62	316.6	0.32	0.02	6.41	1493.
19	11.63	32.556	19	24.785	317.8	11.63	317.1	0.61	0.06	6.39	1493.
29	11.62	32.560	29	24.790	317.5	11.62	316.7	0.93	0.14	6.39	1494.
48	5.96	32.771	48	25.823	219.2	5.96	218.4	1.45	0.34	7.04	1473.
72	4.93	32.782	72	25.952	207.1	4.92	206.2	1.94	0.65	7.06	1469.
98	4.05	32.811	97	26.067	196.1	4.04	195.1	2.45	1.09	7.15	1466.
122	4.33	33.088	121	26.258	178.3	4.32	177.0	2.91	1.60	6.49	1468.
147	4.91	33.595	146	26.597	146.6	4.90	144.8	3.31	2.16	5.23	1471.
172	4.78	33.726	171	26.715	135.6	4.77	133.6	3.67	2.73	4.67	1471.
196	4.74	33.802	195	26.780	129.8	4.73	127.4	3.99	3.33	3.87	1472.
247	4.44	33.836	245	26.840	124.4	4.42	121.7	4.62	4.77	3.11	1471.
298	4.06	33.873	296	26.909	118.1	4.04	115.1	5.25	6.50	2.40	1470.
399	3.81	33.980	396	27.019	108.3	3.78	104.6	6.39	10.55	1.66	1471.
501	3.74	34.096	497	27.119	99.7	3.70	95.2	7.45	15.42	1.30	1473.
601	3.54	34.175	596	27.201	92.4	3.50	87.3	8.41	20.80	1.12	1474.
678	3.42	34.213	672	27.243	88.9	3.37	83.3	9.10	25.33	0.81	1474.
873	3.10	34.323	865	27.361	78.7	3.04	72.0	10.73	38.23	0.93	1476.
1066	2.81	34.392	1056	27.442	71.6	2.74	64.2	12.18	52.54	0.83	1478.
1356	2.48	34.456	1342	27.521	64.8	2.39	56.6	14.15	76.87	1.01	1482.
1838	2.07	34.568	1816	27.645	54.1	1.94	44.7	16.99	122.97	1.38	1488.
2320	1.83	34.616*	2290	27.702	49.5	1.67	39.0	19.46	175.42	1.80	1495.
2803	1.65	34.631*	2764	27.727	47.7	1.45	36.4	21.80	236.42	0.0	1503.
3292	1.56	34.638	3242	27.740	47.3	1.31	35.0	24.11	308.46	3.14	1511.
3786	1.52	34.655	3725	27.764	46.2	1.22	32.3	26.43	391.97	0.0	1519.



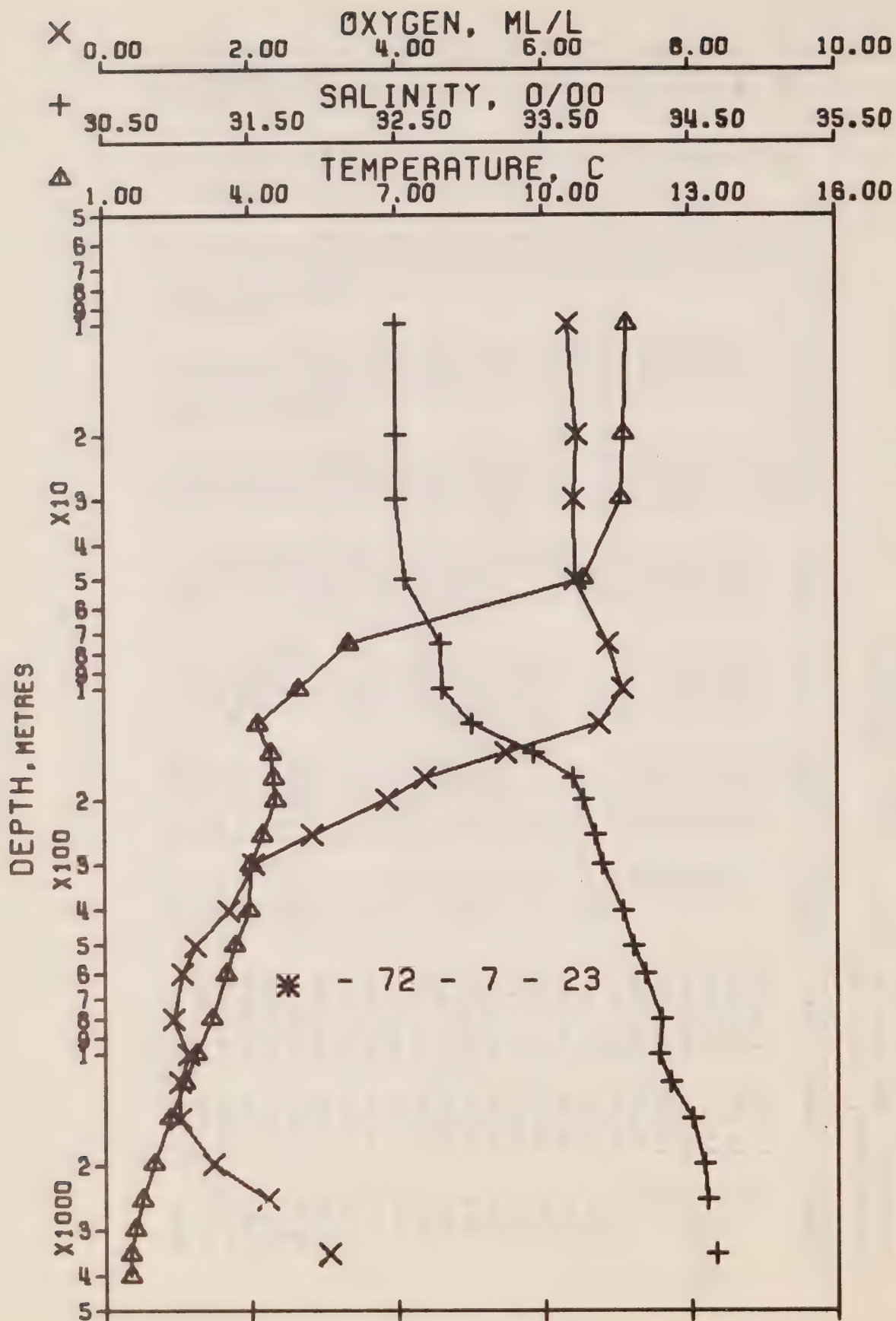
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 7- 19 DATE 9/10/72

POSITION 50- 0.0 N. 145- 0.0 W GMT 17.9

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	11.53	32.551	0	24.799	316.0	11.53	315.8	0.0	0.0	6.50	1493.
10	11.52	32.540	10	24.793	316.8	11.52	316.4	0.32	0.02	6.44	1493.
20	11.52	32.547	20	24.798	316.6	11.52	315.9	0.64	0.07	6.39	1493.
30	11.52	32.546	30	24.797	316.9	11.52	315.9	0.96	0.15	6.39	1493.
50	11.28	32.559	50	24.851	312.2	11.27	310.8	1.60	0.41	6.45	1493.
75	5.03	32.766	75	25.928	209.4	5.02	208.4	2.26	0.82	7.07	1469.
101	4.20	32.785	100	26.031	199.6	4.19	198.6	2.76	1.28	7.20	1466.
126	3.83	32.959	125	26.206	183.1	3.82	181.9	3.24	1.84	6.89	1465.
152	4.36	33.620	151	26.611	145.3	4.95	143.4	3.67	2.44	5.43	1471.
177	5.25	33.759	176	26.688	138.5	5.24	136.1	4.02	3.04	5.01	1473.
202	5.12	33.814	201	26.747	133.2	5.10	130.6	4.37	3.70	4.23	1473.
254	4.58	33.830	252	26.820	126.5	4.56	123.6	5.03	5.25	3.42	1472.
304	4.06	33.859	302	26.898	119.2	4.04	116.2	5.65	7.01	2.44	1471.
406	3.81	33.974	403	27.015	108.8	3.78	105.1	6.81	11.20	1.64	1471.
508	3.72	34.091	504	27.117	99.9	3.68	95.3	7.87	16.15	1.29	1473.
608	3.57	34.173	603	27.197	93.0	3.53	87.6	8.84	21.64	1.17	1474.
725	3.29	34.274	719	27.304	83.3	3.24	77.4	9.87	28.65	1.00	1475.
930	2.93	34.355	921	27.402	74.8	2.87	68.1	11.46	42.13	0.88	1477.
1132	2.71	34.398	1121	27.455	70.4	2.63	62.9	12.93	57.54	0.97	1479.
1435	2.40	34.452	1420	27.525	64.5	2.30	56.2	14.97	84.33	1.14	1483.
1939	2.01	34.584	1916	27.662	52.6	1.88	43.0	17.91	134.48	1.40	1490.
2443	1.77	34.604*	2411	27.697	50.0	1.60	39.5	20.46	191.61	1.63	1497.
2951	1.62	34.603	2909	27.707	49.7	1.40	38.2	23.00	261.57	2.47	1505.
3467	1.54	34.672	3413	27.768	45.1	1.27	32.1	25.44	341.17	3.15	1514.
3923	1.53	34.684	3926	27.779	45.5	1.21	30.7	27.80	431.25	3.47	1523.



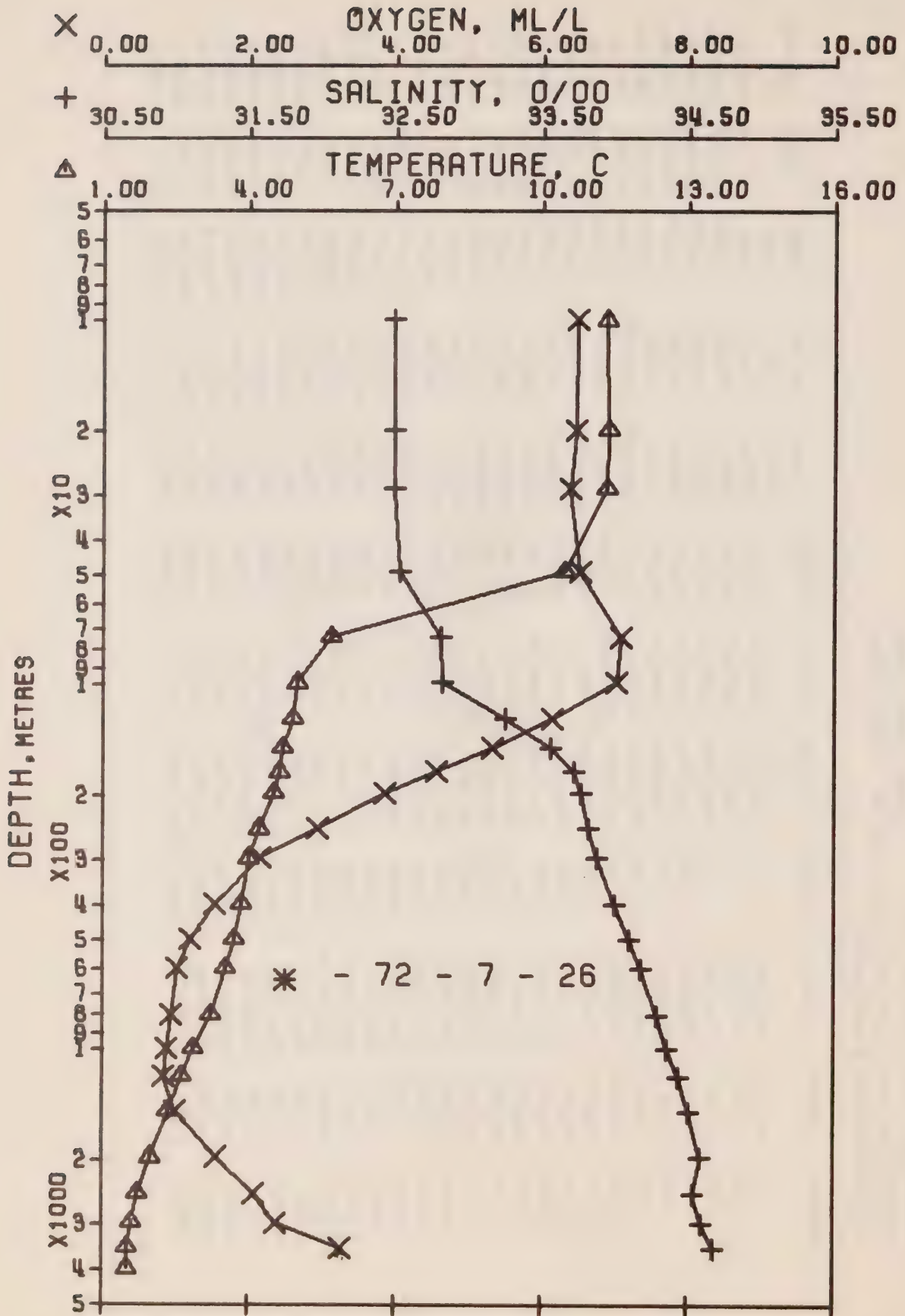
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 7- 23 DATE 18/10/72

POSITION 50- 0.0 N. 145- 0.0 W GMT 17.7

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	11.72	32.510	0	24.733	322.3	11.72	322.1	0.0	0.0	6.40	1493.
10	11.71	32.505	10	24.731	322.7	11.71	322.3	0.32	0.02	6.35	1493.
20	11.66	32.500	20	24.736	322.5	11.66	321.8	0.65	0.07	6.45	1493.
30	11.60	32.499	30	24.746	321.7	11.60	320.8	0.97	0.15	6.42	1493.
50	10.82	32.564	50	24.936	304.0	10.81	302.7	1.61	0.41	6.43	1491.
75	6.01	32.796	75	25.837	218.2	6.00	217.1	2.27	0.82	6.89	1473.
101	4.99	32.815	100	25.971	205.5	4.98	204.3	2.79	1.30	7.09	1470.
126	4.16	33.004	125	26.212	182.6	4.15	181.4	3.28	1.87	6.75	1467.
151	4.42	33.428	150	26.518	153.9	4.41	152.3	3.71	2.46	5.49	1469.
176	4.48	33.701	175	26.728	134.3	4.47	132.3	4.06	3.06	4.38	1470.
202	4.52	33.771	201	26.780	129.7	4.50	127.4	4.41	3.72	3.86	1471.
253	4.25	33.848	251	26.869	121.6	4.23	118.9	5.04	5.19	2.83	1470.
304	4.01	33.902	302	26.937	115.5	3.99	112.4	5.65	6.92	2.04	1470.
406	3.96	34.045	403	27.056	105.0	3.93	101.1	6.77	10.98	1.70	1472.
508	3.68	34.115	504	27.140	97.7	3.64	93.2	7.80	15.79	1.25	1473.
607	3.50	34.194	602	27.220	90.6	3.46	85.5	8.73	21.08	1.05	1474.
806	3.19	34.297	799	27.332	81.1	3.13	74.8	10.43	33.34	0.94	1476.
1005	2.87	34.376*	995	27.424	73.1	2.80	66.0	11.96	47.41	1.14	1478.
1204	2.62	34.439*	1192	27.496	66.8	2.54	59.1	13.35	63.09	1.03	1480.
1506	2.33	34.512	1490	27.579	59.7	2.23	51.1	15.25	89.38	1.02	1484.
2014	1.98	34.591	1989	27.670	52.0	1.84	42.2	18.05	139.55	1.47	1491.
2526	1.74	34.606	2492	27.701	49.8	1.56	39.0	20.64	199.61	2.23	1498.
3042	1.59	34.636*	2998	27.736	47.2	1.36	35.4	23.15	270.63	0.0	1507.
3560	1.52	34.674	3504	27.771	44.9	1.24	31.7	25.53	350.70	3.06	1515.
4080	1.52	34.712*	4011	27.802	43.7	1.19	28.6	27.83	440.22	0.0	1524.



OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 7- 26 DATE 26/10/72

POSITION 50- 0.0 N. 145- 0.0 W GMT 17.8

HYDROGRAPHIC CAST DATA

DEPSS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	PAT. EN	CHY	SOUND
0	11.34	32.503	0	24.797	316.3	11.34	316.0	0.0	0.0	6.48	1492.
10	11.32	32.492	10	24.792	317.0	11.32	316.5	0.32	0.02	6.47	1492.
20	11.34	32.489	20	24.786	317.8	11.34	317.0	0.64	0.07	6.45	1492.
29	11.32	32.494	29	24.793	317.2	11.32	316.3	0.93	0.14	6.39	1492.
49	10.46	32.526	49	24.969	300.9	10.45	299.6	1.56	0.39	6.52	1490.
74	5.68	32.814	74	25.891	213.0	5.67	211.9	2.20	0.79	7.08	1472.
100	4.98	32.810	99	25.975	205.1	4.97	203.8	2.72	1.25	7.01	1470.
125	4.91	33.254	124	26.327	171.9	4.90	170.4	3.20	1.80	6.14	1470.
150	4.69	33.563	149	26.596	146.6	4.68	144.9	3.59	2.36	5.32	1470.
175	4.64	33.716	174	26.723	134.9	4.63	132.9	3.95	2.94	4.55	1471.
200	4.52	33.771	199	26.780	129.7	4.51	127.4	4.28	3.57	3.86	1471.
251	4.21	33.824	249	26.855	122.9	4.19	120.3	4.91	5.04	2.93	1470.
301	4.00	33.885	299	26.925	116.6	3.98	113.7	5.52	6.73	2.16	1470.
403	3.84	34.005	400	27.036	106.8	3.81	103.0	6.65	10.81	1.54	1471.
504	3.70	34.099	500	27.125	99.1	3.66	94.5	7.69	15.61	1.20	1473.
604	3.52	34.182	599	27.209	91.7	3.48	86.6	8.64	20.99	1.02	1474.
813	3.21	34.292	806	27.326	81.7	3.15	75.4	10.44	34.03	0.93	1476.
1005	2.87	34.364	995	27.414	74.0	2.80	66.9	11.93	47.80	0.88	1478.
1198	2.63	34.441	1186	27.497	66.7	2.55	59.0	13.29	63.03	0.84	1480.
1494	2.34	34.508	1478	27.575	60.0	2.24	51.5	15.15	88.63	1.01	1484.
1998	1.98	34.586	1974	27.666	52.3	1.84	42.6	17.95	138.37	1.56	1491.
2511	1.73	34.595*	2477	27.693	50.4	1.55	39.9	20.56	198.44	2.09	1498.
3028	1.59	34.603	2984	27.709	49.5	1.37	38.0	23.15	271.84	2.37	1506.
3545	1.52	34.678	3489	27.775	44.6	1.25	31.5	25.60	353.51	3.26	1515.
4055	1.52	34.752*	3987	27.834	40.8	1.19	25.5	27.78	437.79	0.0	1524.

RESULTS OF STD CASTS

(P-72-7)

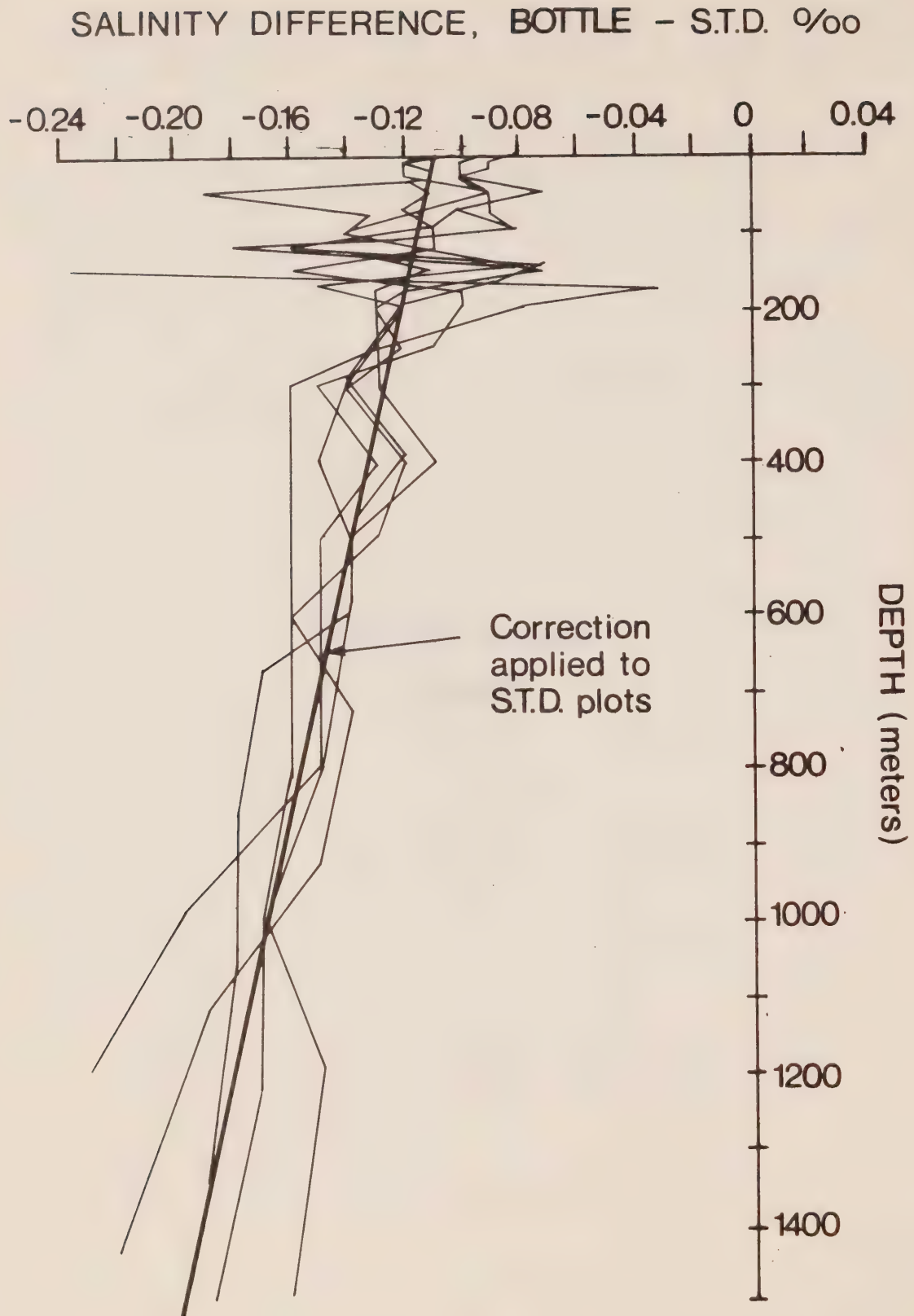


Figure 5 Bottle - STD salinity value difference profiles. P-72-7.

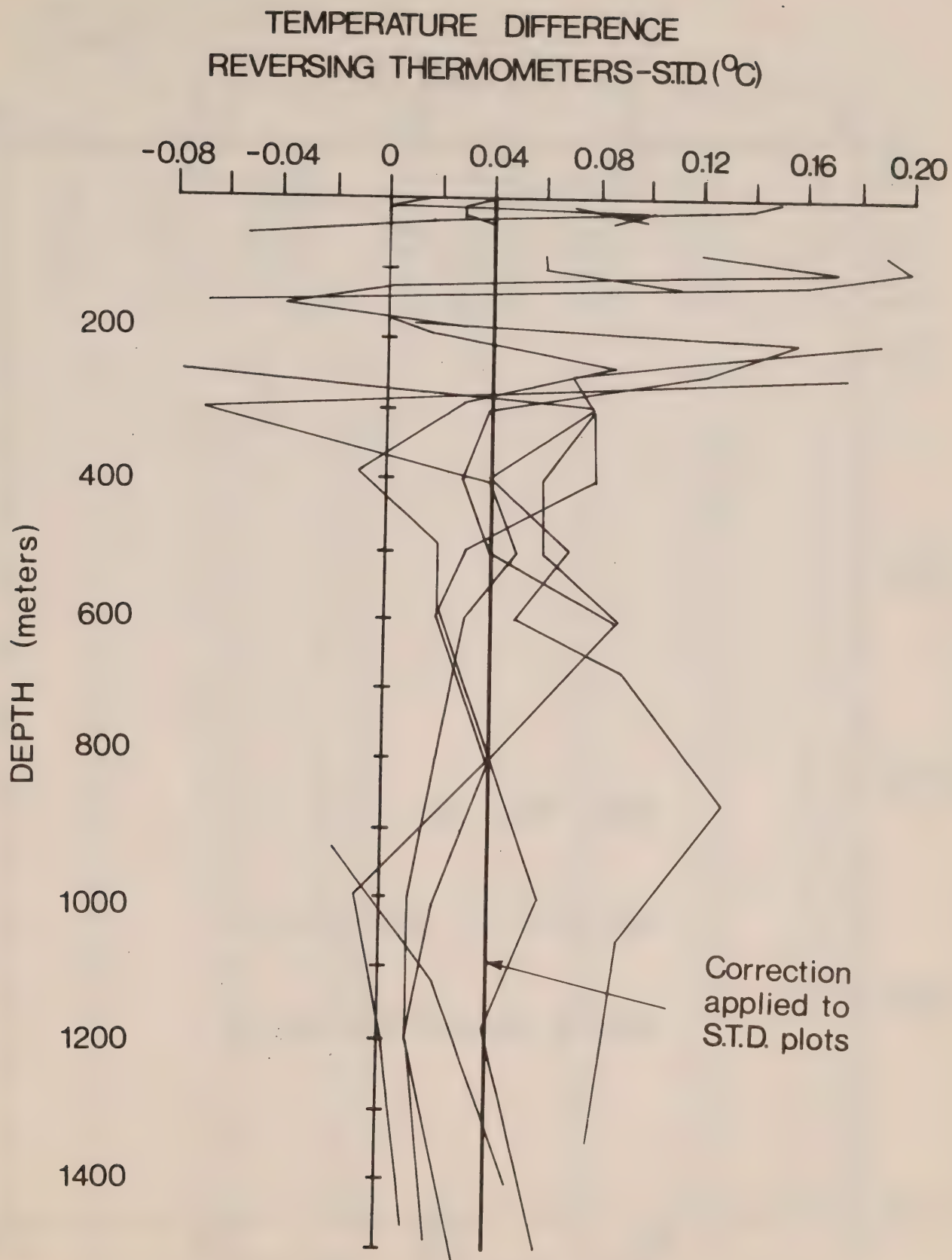
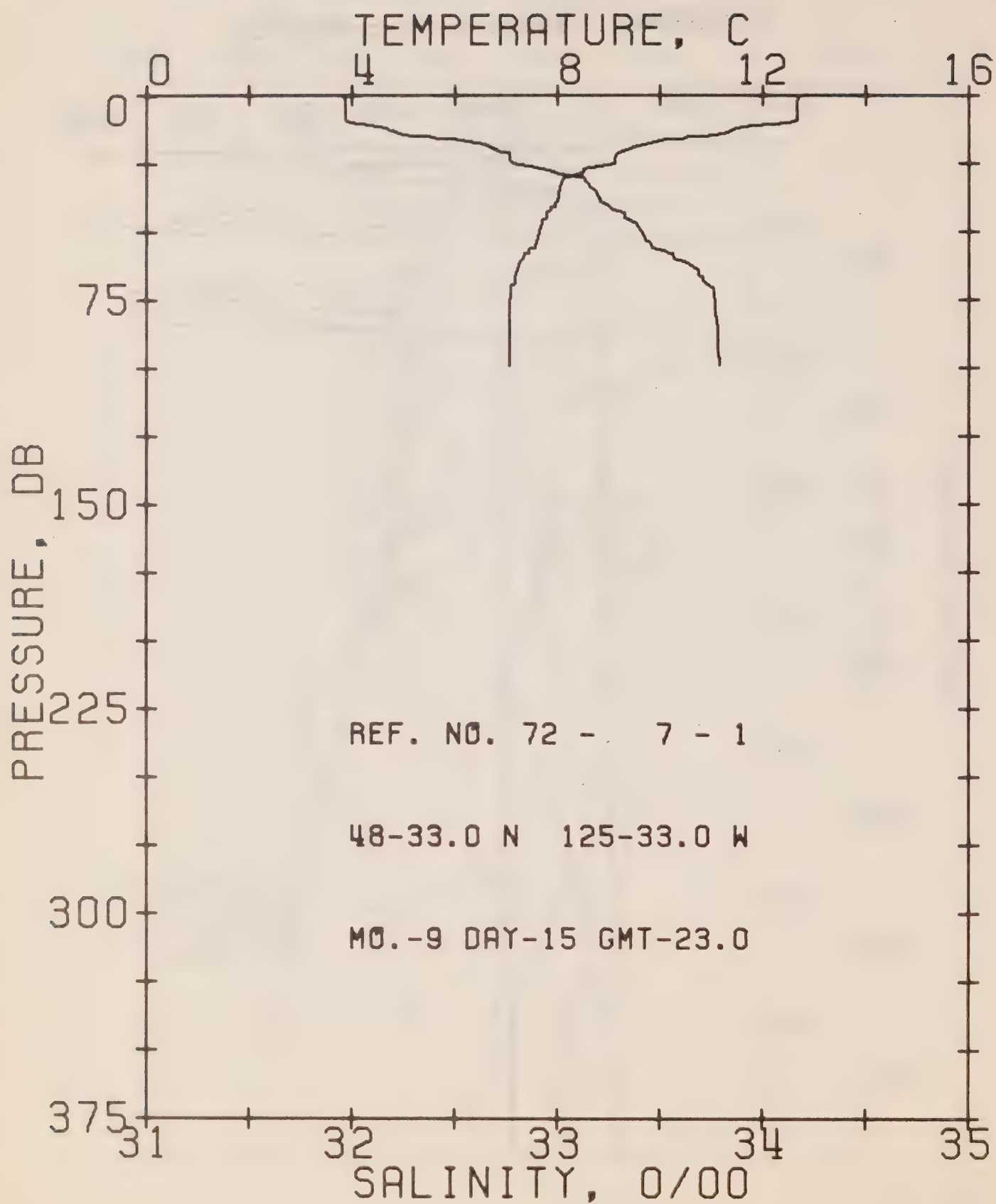


Figure 6

Temperature difference reversing thermometers - STD. P-72-7.



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REFERENCE NO. 72- 7- 1

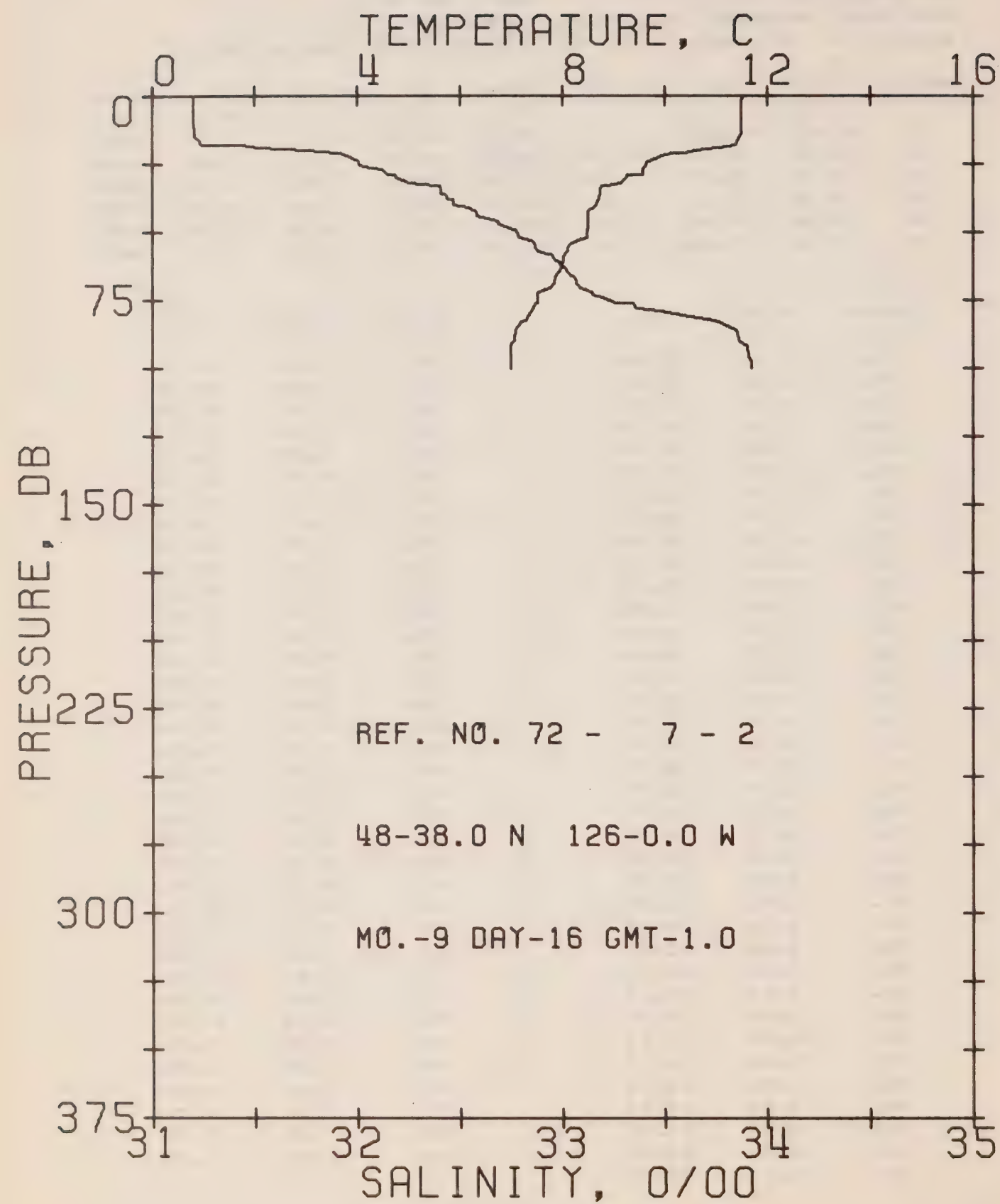
DATE 15/ 9/72

POSITION 48-33.0N, 125-33.0W GMT 23.0

RESULTS OF STP CAST 73 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	12.68	31.96	0	24.13	379.8	0.0	0.0	1496.
10	12.51	31.99	10	24.18	375.0	0.38	0.02	1496.
20	9.35	32.70	20	25.29	269.9	0.69	0.07	1485.
30	8.20	33.11	30	25.79	222.7	0.95	0.13	1482.
50	7.66	33.41	50	26.10	193.1	1.36	0.30	1480.
75	7.08	33.76	75	26.46	159.4	1.80	0.57	1479.

DEPTH	TEMP	SAL	DEPTH	TEMP	SAL
0.	12.68	31.96	40.	7.94	33.24
4.	12.66	31.97	41.	7.94	33.25
7.	12.66	31.97	41.	7.87	33.25
9.	12.66	31.97	42.	7.87	33.27
10.	12.51	31.99	43.	7.79	33.33
11.	11.82	32.09	45.	7.78	33.33
12.	11.47	32.17	46.	7.72	33.36
13.	11.39	32.18	47.	7.72	33.39
13.	11.39	32.20	47.	7.70	33.38
14.	11.22	32.22	50.	7.66	33.41
15.	10.85	32.29	53.	7.63	33.43
15.	10.56	32.36	54.	7.61	33.45
16.	10.42	32.42	56.	7.58	33.46
16.	10.11	32.49	56.	7.48	33.46
18.	9.67	32.65	57.	7.45	33.52
19.	9.48	32.67	58.	7.43	33.54
20.	9.35	32.70	58.	7.37	33.56
21.	9.21	32.72	59.	7.36	33.56
21.	9.19	32.76	60.	7.33	33.57
22.	9.14	32.77	61.	7.29	33.62
24.	9.13	32.77	63.	7.24	33.66
24.	9.12	32.77	64.	7.22	33.69
25.	9.11	32.78	66.	7.19	33.69
26.	8.80	32.86	67.	7.18	33.71
27.	8.52	32.92	68.	7.17	33.71
28.	8.50	32.98	69.	7.16	33.72
29.	8.42	33.01	70.	7.10	33.74
30.	8.20	33.11	71.	7.10	33.76
30.	8.14	33.12	73.	7.09	33.76
34.	8.06	33.16	77.	7.08	33.77
34.	8.06	33.17	80.	7.08	33.77
34.	8.06	33.17	86.	7.06	33.78
35.	8.05	33.18	87.	7.06	33.78
36.	8.03	33.19	93.	7.06	33.78
38.	8.02	33.20	94.	7.06	33.78
38.	8.01	33.21	99.	7.06	33.79
39.	8.01	33.21			



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REFERENCE NO. 72- 7- 2

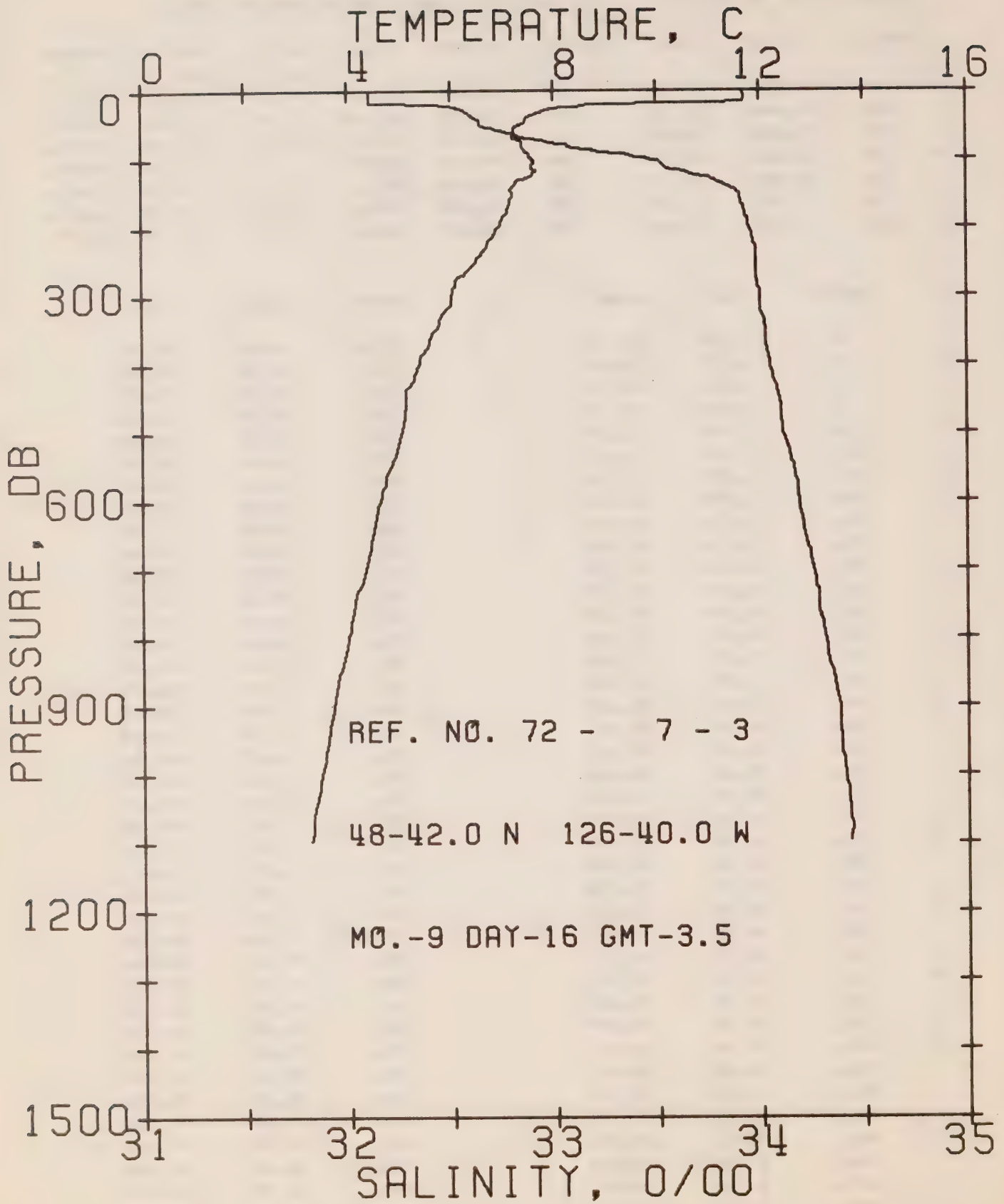
DATE 16/ 9/72

POSITION 48-38.0N, 126- 0.0W GMT 1.0

RESULTS OF STP CAST 81 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.51	31.20	0	23.76	415.2	0.0	0.0	1491.
10	11.48	31.20	10	23.76	415.2	0.42	0.02	1491.
20	10.58	31.75	20	24.35	359.7	0.82	0.08	1489.
30	9.25	32.19	30	24.91	306.4	1.15	0.17	1485.
50	8.49	32.77	50	25.48	252.1	1.70	0.39	1483.
75	7.52	33.23	75	25.98	205.0	2.27	0.75	1480.
100	6.98	33.92	99	26.60	146.8	2.67	1.11	1479.

DEPTH	TEMP	SAL	DEPTH	TEMP	SAL
0.	11.51	31.20	49.	8.49	32.77
3.	11.50	31.20	51.	8.49	32.78
6.	11.50	31.20	52.	8.47	32.79
9.	11.49	31.20	53.	8.28	32.85
10.	11.48	31.20	54.	8.18	32.86
14.	11.48	31.21	56.	8.11	32.87
15.	11.46	31.21	57.	8.10	32.88
16.	11.44	31.22	58.	8.06	32.92
18.	11.38	31.24	58.	8.05	32.94
18.	11.36	31.44	60.	8.03	32.96
19.	11.05	31.52	61.	8.03	32.98
20.	10.58	31.75	61.	8.02	32.99
21.	10.37	31.90	62.	8.00	32.99
21.	10.13	31.92	63.	8.00	33.01
22.	9.95	31.95	65.	7.93	33.03
23.	9.81	31.98	67.	7.87	33.06
24.	9.67	32.00	69.	7.83	33.07
25.	9.66	32.01	70.	7.78	33.08
26.	9.62	32.03	71.	7.69	33.11
27.	9.56	32.12	72.	7.54	33.14
29.	9.56	32.15	73.	7.52	33.15
29.	9.29	32.18	73.	7.52	33.15
30.	9.25	32.19	74.	7.52	33.20
32.	9.14	32.25	75.	7.52	33.23
33.	8.89	32.39	76.	7.51	33.26
33.	8.78	32.40	76.	7.50	33.31
35.	8.76	32.41	76.	7.49	33.34
36.	8.75	32.41	78.	7.44	33.36
36.	8.75	32.42	78.	7.43	33.37
38.	8.72	32.44	79.	7.42	33.48
38.	8.71	32.47	81.	7.33	33.62
39.	8.68	32.47	82.	7.31	33.71
40.	8.67	32.47	83.	7.19	33.77
41.	8.60	32.54	84.	7.18	33.79
42.	8.53	32.57	86.	7.09	33.85
43.	8.51	32.58	90.	7.06	33.86
44.	8.51	32.58	92.	6.99	33.90
46.	8.50	32.68	96.	6.98	33.91
47.	8.51	32.69	98.	6.98	33.92
48.	8.50	32.72	100.	6.98	33.92
49.	8.50	32.76			



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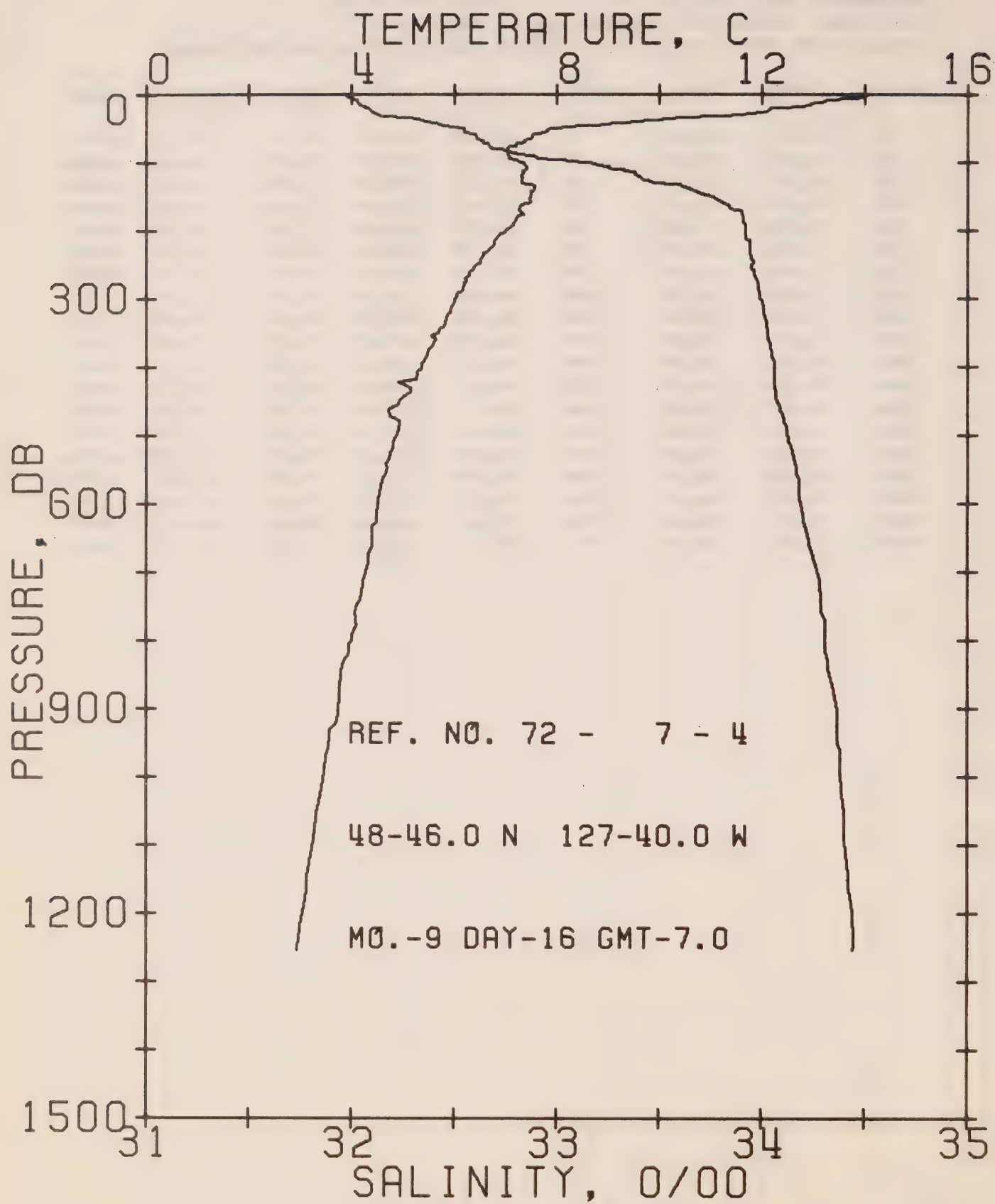
REFERENCE NO. 72- 7- 3

DATE 16/ 9/72

POSITION 48-42.0N, 126-40.0W GMT 3.5

RESULTS OF STP CAST 214 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.68	32.11	0	24.43	350.9	0.0	0.0	1493.
10	11.71	32.11	10	24.42	351.9	0.35	0.02	1493.
20	9.21	32.31	20	25.01	296.7	0.69	0.07	1484.
30	7.76	32.57	30	25.43	256.8	0.96	0.14	1479.
50	7.39	32.64	50	25.53	246.8	1.46	0.34	1478.
75	7.38	32.97	75	25.79	222.8	2.05	0.71	1479.
100	7.58	33.46	99	26.15	189.1	2.57	1.17	1481.
125	7.55	33.71	124	26.35	170.3	3.02	1.69	1482.
150	7.20	33.90	149	26.55	152.0	3.42	2.25	1481.
175	7.09	33.92	174	26.58	149.3	3.79	2.87	1481.
200	6.92	33.95	199	26.62	145.5	4.16	3.58	1481.
225	6.70	33.97	223	26.67	141.0	4.52	4.35	1480.
250	6.47	33.98	248	26.71	137.9	4.87	5.19	1480.
300	6.01	34.00	298	26.79	131.1	5.54	7.07	1479.
400	5.36	34.05	397	26.90	120.6	6.80	11.56	1478.
500	5.02	34.11	496	26.99	113.1	7.96	16.88	1478.
600	4.62	34.19	595	27.10	103.5	9.04	22.91	1478.
800	3.98	34.31	793	27.27	88.8	10.96	36.56	1479.
1000	3.45	34.41	991	27.40	77.0	12.60	51.62	1480.



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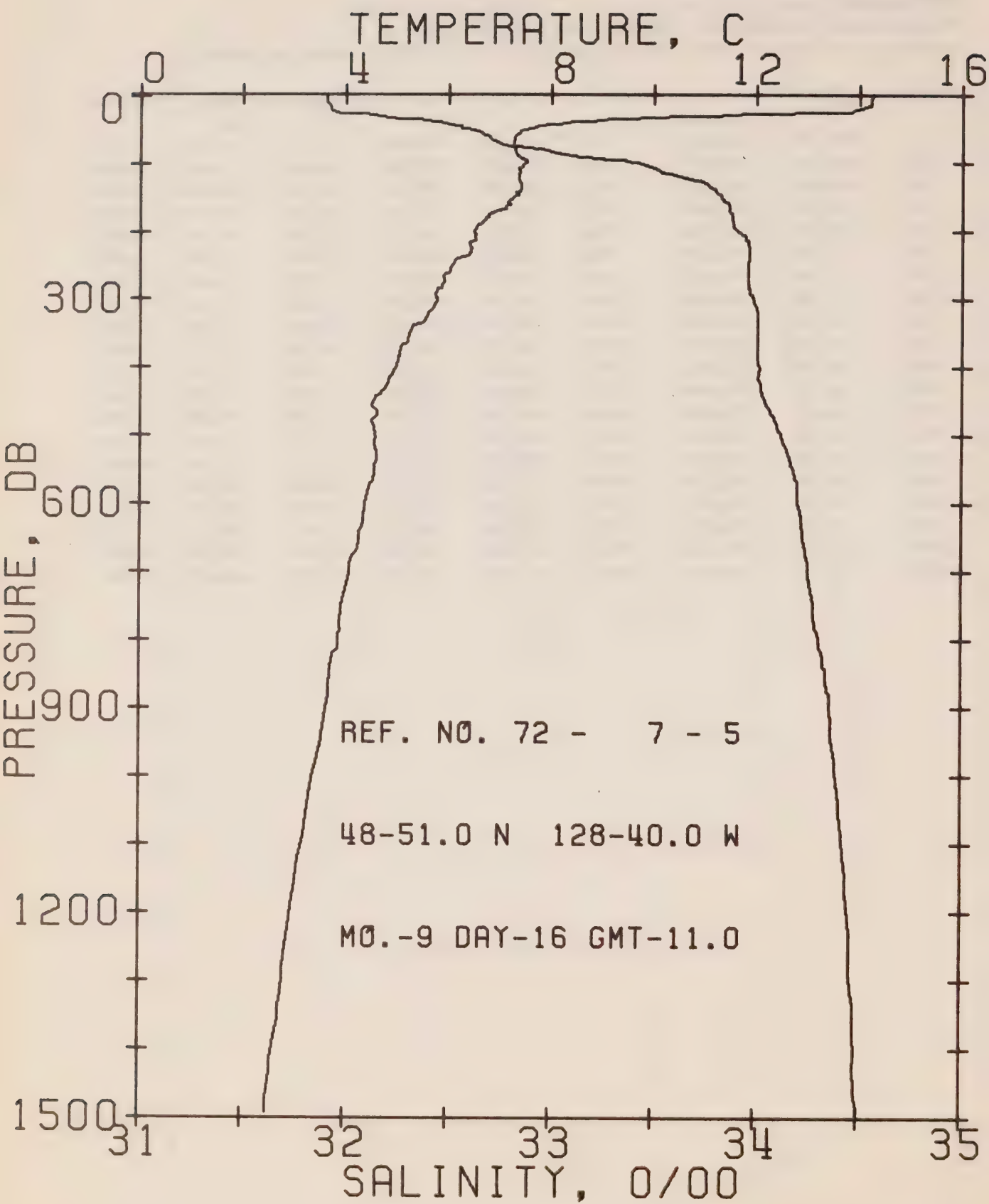
REFERENCE NO. 72- 7- 4

DATE 16/ 9/72

POSITION 48-46.0N. 127-40.0W -- GMT 7.0

RESULTS OF STP CAST 265 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	14.04	31.97	0	23.86	404.8	0.0	0.0	1501.
10	13.25	32.03	10	24.07	385.8	0.40	0.02	1498.
20	12.46	32.07	20	24.25	368.4	0.78	0.08	1496.
30	11.70	32.12	30	24.44	351.0	1.14	0.17	1493.
50	8.03	32.55	50	25.37	262.3	1.74	0.41	1481.
75	7.20	32.67	75	25.58	242.7	2.37	0.81	1478.
100	7.28	33.12	99	25.92	210.7	2.95	1.32	1479.
125	7.32	33.42	124	26.16	189.0	3.44	1.89	1480.
150	7.50	33.75	149	26.39	167.3	3.88	2.51	1482.
175	7.33	33.90	174	26.53	154.3	4.28	3.17	1482.
200	6.98	33.92	199	26.60	148.3	4.66	3.89	1481.
225	6.70	33.94	223	26.65	143.4	5.02	4.68	1480.
250	6.46	33.95	248	26.69	139.6	5.38	5.54	1480.
300	6.01	33.99	298	26.78	131.9	6.05	7.43	1479.
400	5.35	34.06	397	26.91	119.7	7.31	11.90	1478.
500	4.86	34.12	496	27.02	110.3	8.45	17.14	1477.
600	4.51	34.18	595	27.11	102.5	9.51	23.05	1478.
800	3.99	34.31	793	27.26	89.0	11.41	36.57	1479.
1000	3.44	34.38	991	27.38	78.9	13.07	51.80	1480.
1200	3.03	34.44	1188	27.46	71.3	14.58	68.67	1482.



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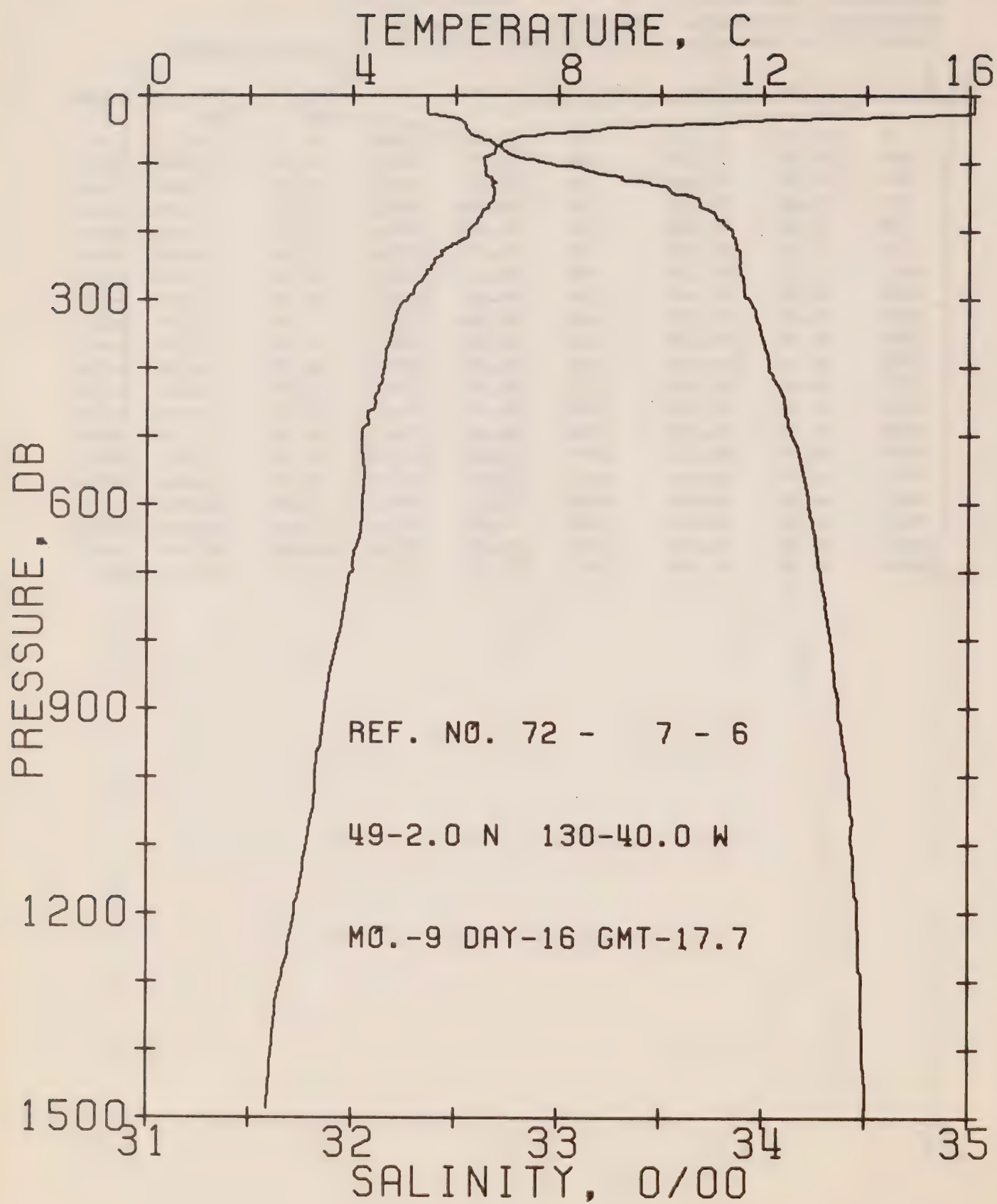
REFERENCE NO. 72- 7- 5

DATE 16/ 9/72

POSITION 48-51.0N. 128-40.0W GMT 11.0

RESULTS OF STP CAST 265 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	14.28	31.90	0	23.76	414.8	0.0	0.0	1501.
10	14.21	31.91	10	23.78	413.1	0.41	0.02	1501.
20	14.06	31.93	20	23.83	408.9	0.83	0.08	1501.
30	11.63	32.12	30	24.45	350.2	1.22	0.18	1493.
50	7.66	32.56	50	25.43	256.4	1.79	0.42	1479.
75	7.26	32.80	75	25.68	233.6	2.40	0.80	1478.
100	7.52	33.39	99	26.11	193.3	2.94	1.28	1481.
125	7.38	33.69	124	26.36	169.8	3.39	1.79	1481.
150	7.28	33.83	149	26.48	158.3	3.80	2.37	1481.
175	6.82	33.88	174	26.58	148.8	4.18	3.00	1480.
200	6.50	33.90	199	26.65	143.2	4.55	3.70	1479.
225	6.45	33.97	223	26.71	138.0	4.90	4.46	1479.
250	6.07	33.96	248	26.75	134.1	5.24	5.28	1478.
300	5.79	33.99	298	26.81	129.1	5.90	7.13	1478.
400	4.97	34.02	397	26.92	118.4	7.12	11.50	1476.
500	4.58	34.12	496	27.05	107.2	8.25	16.66	1476.
600	4.38	34.20	595	27.13	99.9	9.29	22.45	1477.
800	3.86	34.31	793	27.28	87.6	11.16	35.76	1478.
1000	3.37	34.39	991	27.39	77.4	12.80	50.80	1480.
1200	2.95	34.45	1188	27.48	69.6	14.27	67.21	1481.



OFFSHORE OCEANOGRAPHY GROUP

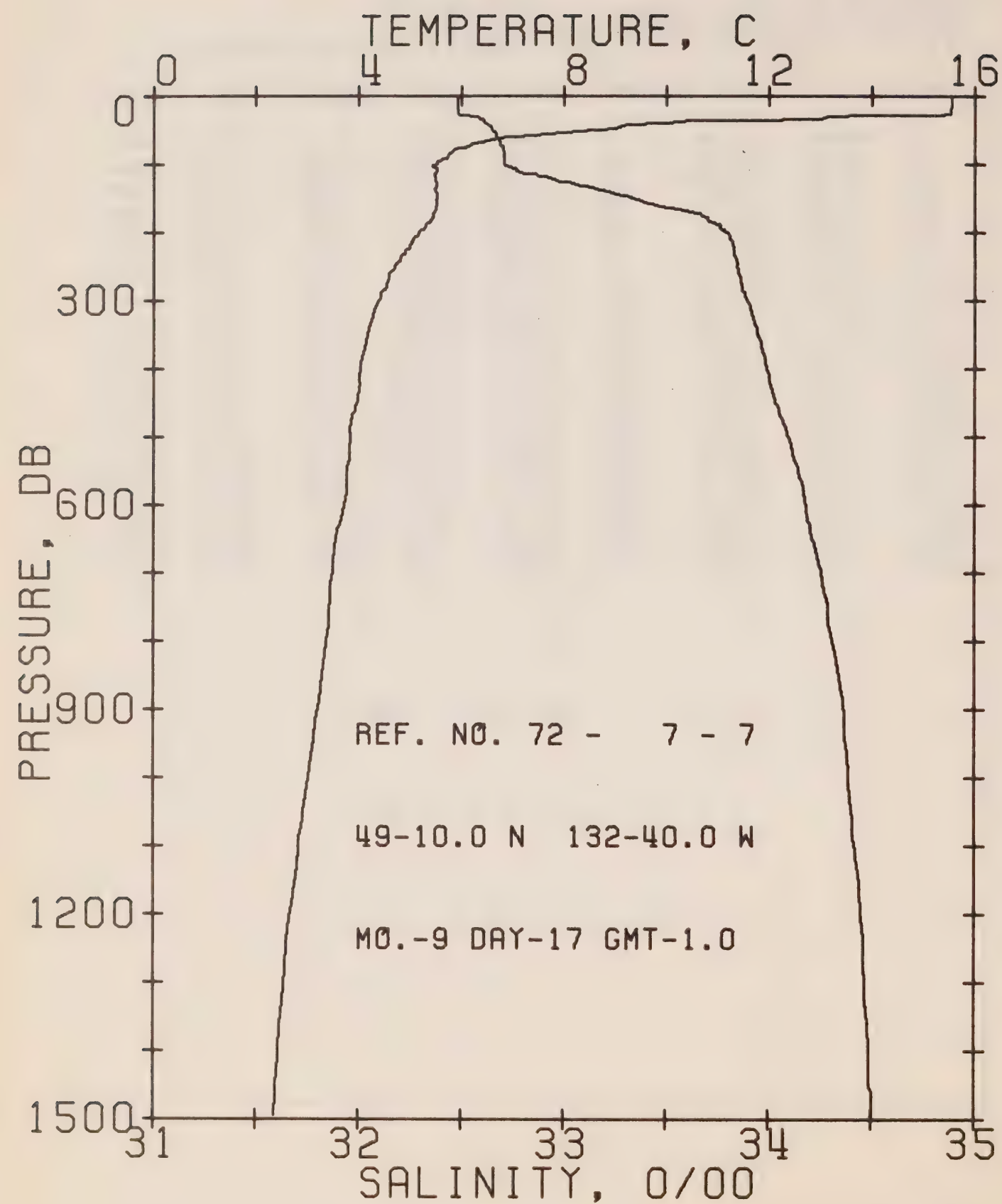
REFERENCE NO. 72- 7- 6

DATE 16/ 9/72

POSITION 49- 2.0N, 130-40.0W GMT 17.7

RESULTS OF STP CAST 257 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	16.09	32.36	0	23.72	418.4	0.0	0.0	1508.
10	16.08	32.36	10	23.73	418.7	0.42	0.02	1508.
20	16.08	32.36	20	23.73	418.9	0.84	0.09	1508.
30	15.32	32.41	30	23.93	399.6	1.25	0.19	1506.
50	8.86	32.55	50	25.25	274.2	1.90	0.45	1484.
75	6.79	32.71	75	25.67	234.5	2.53	0.85	1476.
100	6.56	32.93	99	25.88	214.8	3.09	1.35	1476.
125	6.69	33.32	124	26.16	188.2	3.59	1.92	1478.
150	6.73	33.66	149	26.42	163.6	4.03	2.53	1479.
175	6.47	33.76	174	26.54	153.2	4.42	3.19	1478.
200	6.24	33.85	199	26.64	143.9	4.80	3.90	1478.
225	5.78	33.87	223	26.71	137.0	5.15	4.67	1476.
250	5.52	33.88	248	26.75	133.2	5.49	5.48	1476.
300	5.03	33.93	298	26.85	124.5	6.13	7.29	1475.
400	4.60	34.03	397	26.98	113.2	7.31	11.48	1475.
500	4.20	34.14	496	27.10	101.6	8.38	16.38	1475.
600	4.19	34.22	555	27.17	96.3	9.36	21.89	1476.
800	3.72	34.33	793	27.31	84.4	11.17	34.77	1478.
1000	3.27	34.41	991	27.42	74.6	12.76	49.32	1479.
1200	2.87	34.46	1188	27.49	68.0	14.20	65.36	1481.



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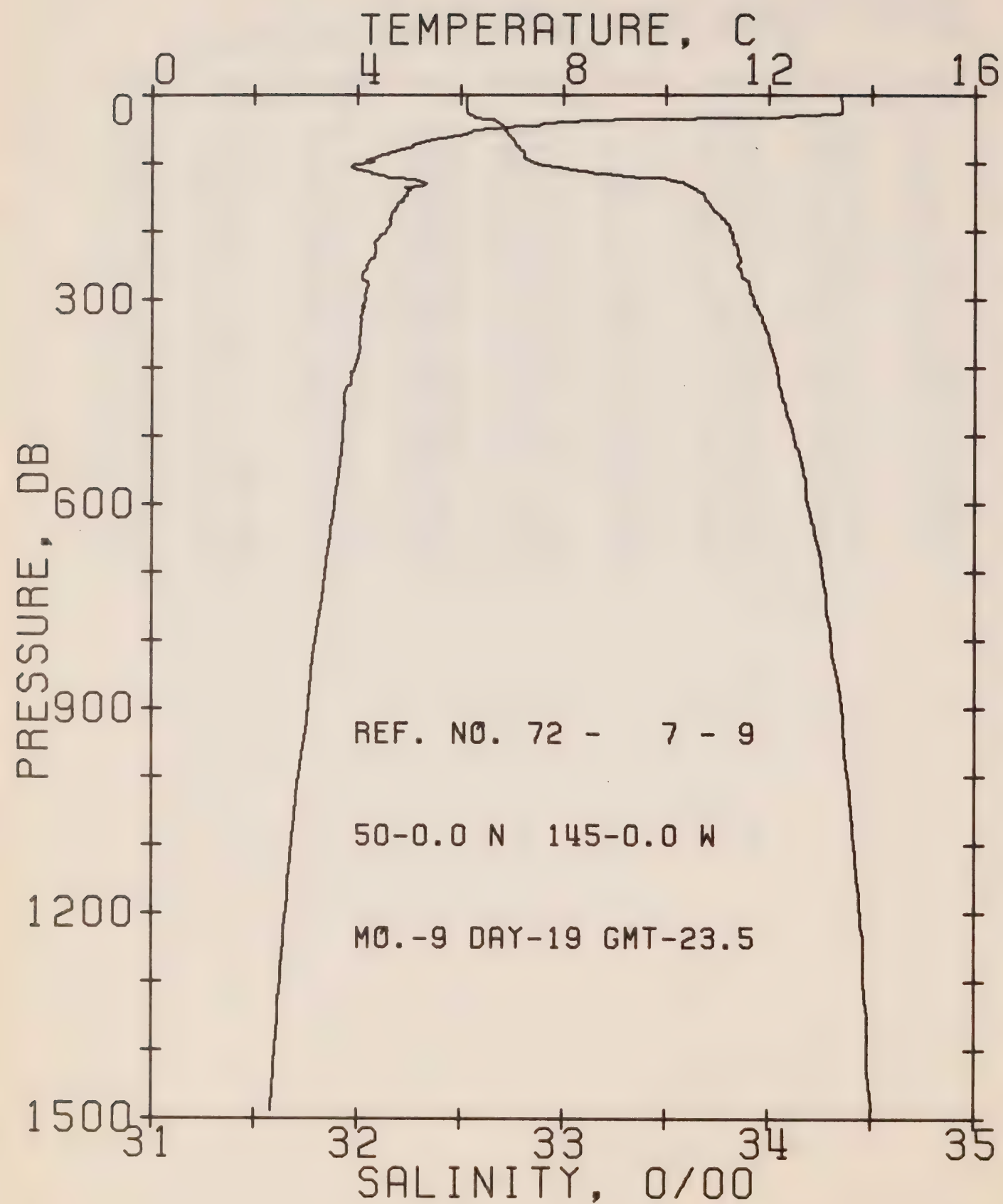
REFERENCE NO. 72- 7- 7

DATE 17/ 9/72

POSITION 49-10.0N, 132-40.0W GMT 1.0

RESULTS OF STP CAST 246 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	15.55	32.48	0	23.94	398.1	0.0	0.0	1506.
10	15.54	32.48	10	23.94	398.4	0.40	0.02	1506.
20	15.53	32.48	20	23.94	398.5	0.80	0.08	1506.
30	13.33	32.55	30	24.46	349.5	1.19	0.18	1499.
50	8.75	32.65	50	25.34	265.2	1.78	0.42	1484.
75	6.07	32.70	75	25.75	226.1	2.38	0.80	1474.
100	5.52	32.71	99	25.83	219.2	2.94	1.29	1472.
125	5.51	32.97	124	26.04	199.7	3.46	1.90	1472.
150	5.51	33.33	149	26.32	173.3	3.93	2.55	1473.
175	5.44	33.67	174	26.60	146.9	4.33	3.21	1474.
200	5.17	33.78	199	26.72	135.8	4.68	3.89	1473.
225	4.94	33.83	223	26.78	130.2	5.02	4.60	1473.
250	4.69	33.85	248	26.82	126.4	5.34	5.38	1472.
300	4.39	33.89	298	26.89	120.2	5.95	7.11	1472.
400	4.02	33.99	397	27.00	109.9	7.10	11.18	1472.
500	3.84	34.09	496	27.11	100.9	8.16	16.03	1473.
600	3.71	34.18	595	27.19	93.9	9.13	21.47	1474.
800	3.37	34.31	793	27.32	82.0	10.87	33.89	1476.
1000	3.01	34.39	990	27.42	73.5	12.42	48.04	1478.
1200	2.65	34.45	1188	27.50	66.4	13.82	63.73	1480.



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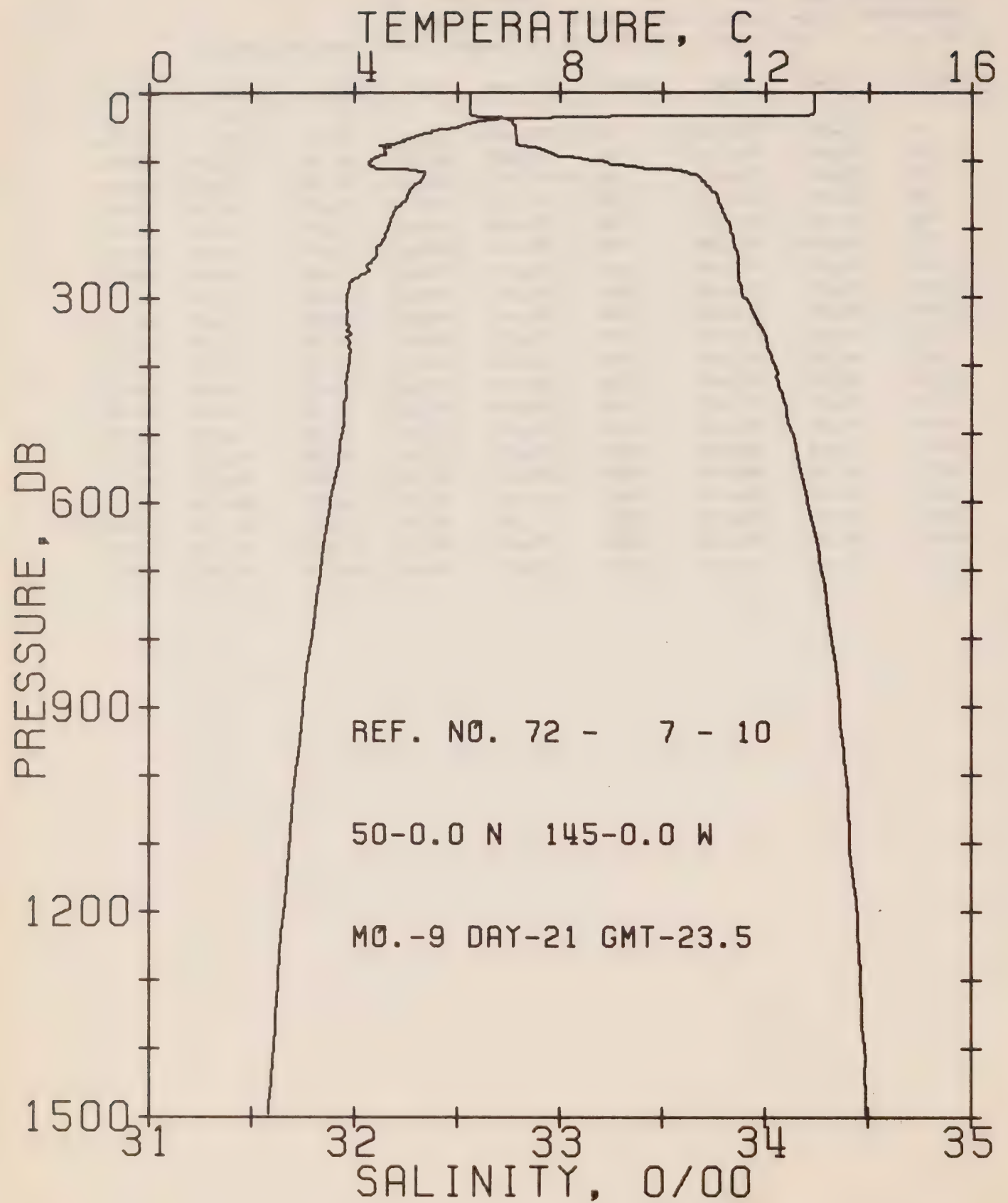
REFERENCE NO. 72- 7- 9

DATE 19/ 9/72

POSITION 50- 0.0N, 145- 0.0W GMT 23.5

RESULTS OF STP CAST : 240 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	13.39	32.53	0	24.43	351.2	0.0	0.0	1499.
10	13.40	32.53	10	24.43	351.8	0.35	0.02	1499.
20	13.40	32.53	20	24.43	352.1	0.70	0.07	1499.
30	12.78	32.55	30	24.56	339.2	1.05	0.16	1498.
50	6.63	32.71	50	25.69	231.9	1.60	0.38	1475.
75	5.08	32.78	75	25.93	208.8	2.15	0.73	1470.
100	4.21	32.86	99	26.09	194.0	2.65	1.18	1466.
125	5.11	33.52	124	26.51	154.3	3.09	1.67	1472.
150	4.91	33.68	149	26.66	140.3	3.45	2.18	1471.
175	4.65	33.75	174	26.75	132.6	3.79	2.75	1471.
200	4.54	33.81	199	26.81	127.0	4.12	3.37	1471.
225	4.35	33.85	223	26.86	122.2	4.43	4.04	1470.
250	4.18	33.85	248	26.88	120.5	4.73	4.78	1470.
300	4.14	33.92	298	26.94	115.3	5.32	6.42	1471.
400	3.93	34.04	397	27.05	105.2	6.42	10.34	1472.
500	3.71	34.12	496	27.14	97.6	7.43	14.97	1473.
600	3.54	34.19	595	27.21	91.6	8.37	20.24	1474.
800	3.17	34.30	793	27.34	80.4	10.08	32.39	1476.
1000	2.86	34.38	990	27.43	72.5	11.60	46.33	1478.
1200	2.60	34.44	1188	27.50	66.1	12.98	61.80	1480.



OFFSHORE OCEANOGRAPHY GROUP

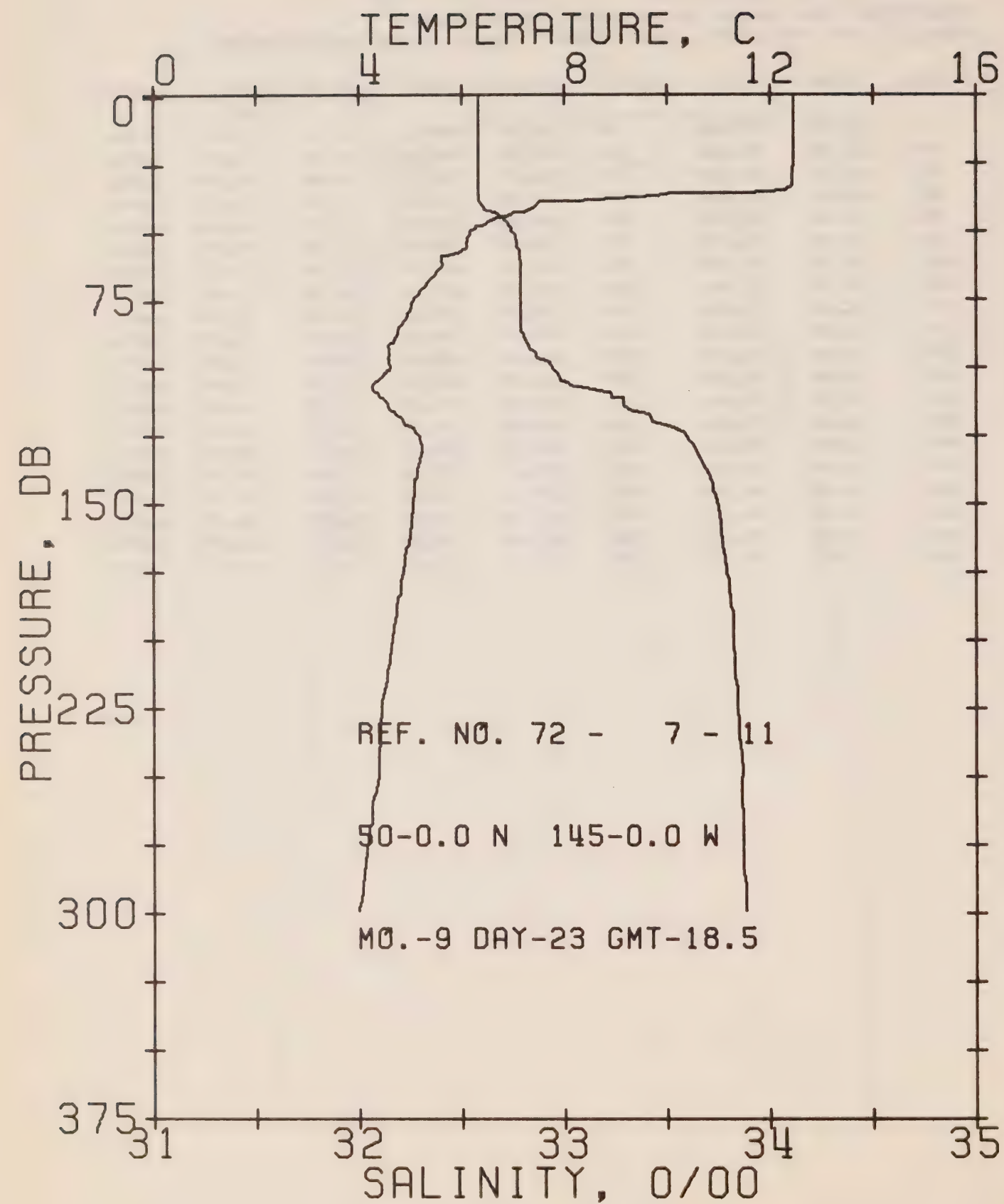
REFERENCE NO. 72- 7- 10

DATE 21/ 9/72

POSITION 50- 0.0N, 145- 0.0W GMT 23.5

RESULTS OF STP CAST 206 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	12.92	32.56	0	24.54	340.1	0.0	0.0	1498.
10	12.92	32.56	10	24.54	340.6	0.34	0.02	1498.
20	12.92	32.56	20	24.54	340.8	0.68	0.07	1498.
30	12.91	32.56	30	24.55	340.9	1.02	0.16	1498.
50	6.05	32.78	50	25.82	219.6	1.53	0.36	1473.
75	4.75	32.79	75	25.98	204.6	2.06	0.70	1468.
100	4.35	33.15	99	26.31	173.6	2.54	1.12	1467.
125	5.32	33.68	124	26.62	144.6	2.93	1.57	1473.
150	5.02	33.76	149	26.72	135.5	3.28	2.06	1472.
175	4.75	33.79	174	26.77	130.6	3.61	2.61	1471.
200	4.64	33.83	199	26.81	126.6	3.93	3.22	1471.
225	4.46	33.85	223	26.85	123.7	4.25	3.90	1471.
250	4.32	33.86	248	26.87	121.4	4.55	4.64	1471.
300	3.84	33.89	298	26.94	114.6	5.14	6.28	1470.
400	3.87	34.04	397	27.06	104.3	6.23	10.15	1472.
500	3.74	34.13	496	27.14	97.4	7.24	14.78	1473.
600	3.52	34.20	595	27.22	90.5	8.18	20.04	1474.
800	3.16	34.32	793	27.35	79.0	9.86	32.00	1475.
1000	2.85	34.39	990	27.44	71.8	11.36	45.75	1478.
1200	2.62	34.44	1188	27.50	66.3	12.75	61.27	1480.



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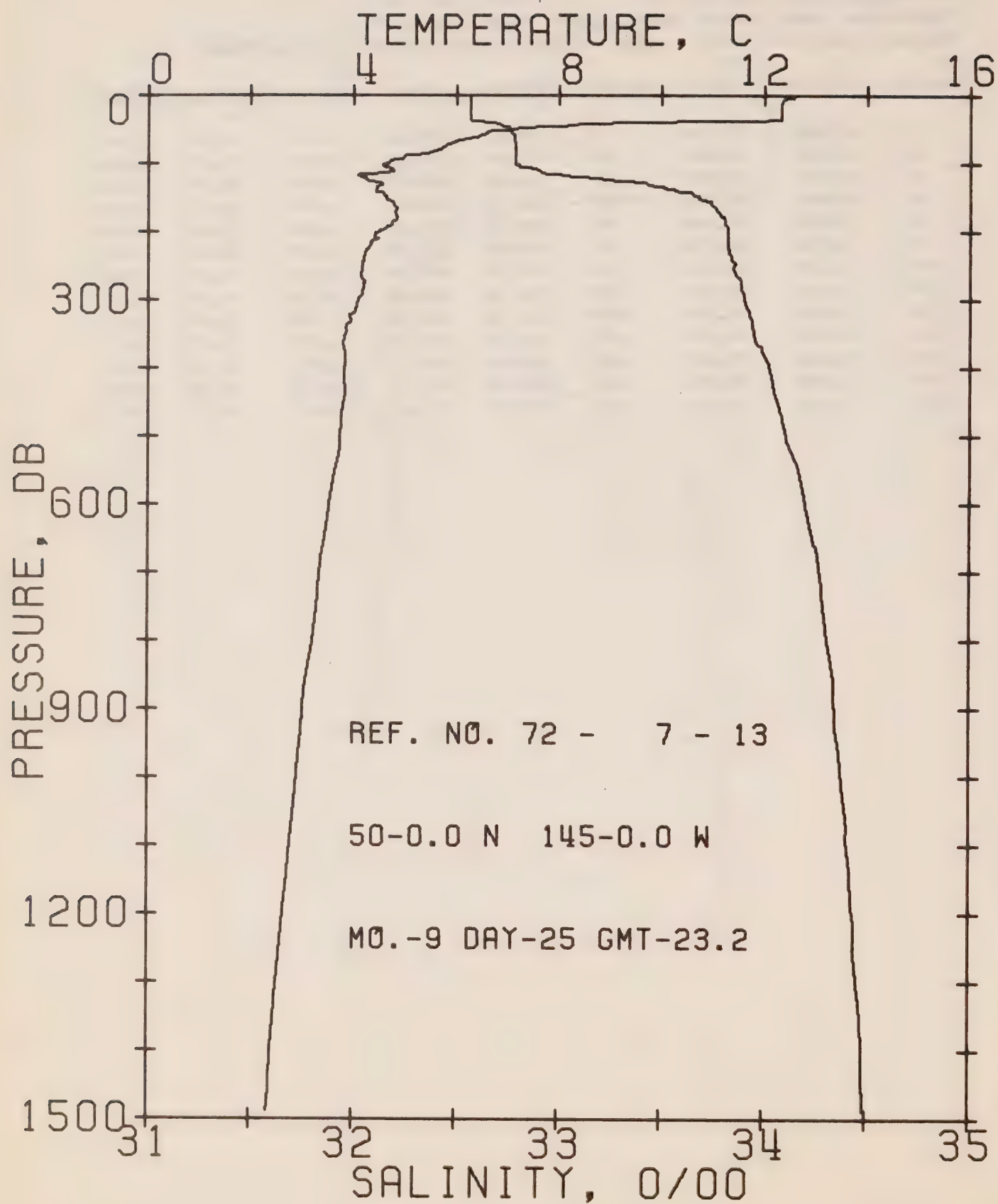
REFERENCE NO. 72- 7- 11

DATE 23/ 9/72

POSITION 50- 0.0N, 145- 0.0W GMT 18.5

RESULTS OF STP CAST 151 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	12.46	32.58	0	24.65	330.2	0.0	0.0	1496.
10	12.45	32.58	10	24.65	330.4	0.33	0.02	1496.
20	12.44	32.58	20	24.65	330.5	0.66	0.07	1496.
30	12.43	32.58	30	24.65	330.6	0.99	0.15	1496.
50	6.16	32.74	50	25.77	223.9	1.53	0.37	1474.
75	5.06	32.79	75	25.94	207.9	2.07	0.71	1470.
100	4.59	32.94	99	26.11	192.0	2.58	1.16	1468.
125	5.18	33.59	124	26.56	149.8	3.00	1.64	1472.
150	5.03	33.74	149	26.70	136.9	3.36	2.14	1472.
175	4.85	33.79	174	26.76	131.6	3.69	2.70	1472.
200	4.63	33.82	199	26.81	127.2	4.01	3.31	1471.
225	4.42	33.84	223	26.85	123.6	4.33	3.99	1471.
250	4.36	33.87	248	26.87	121.3	4.63	4.73	1471.



OFFSHORE OCEANOGRAPHY GROUP

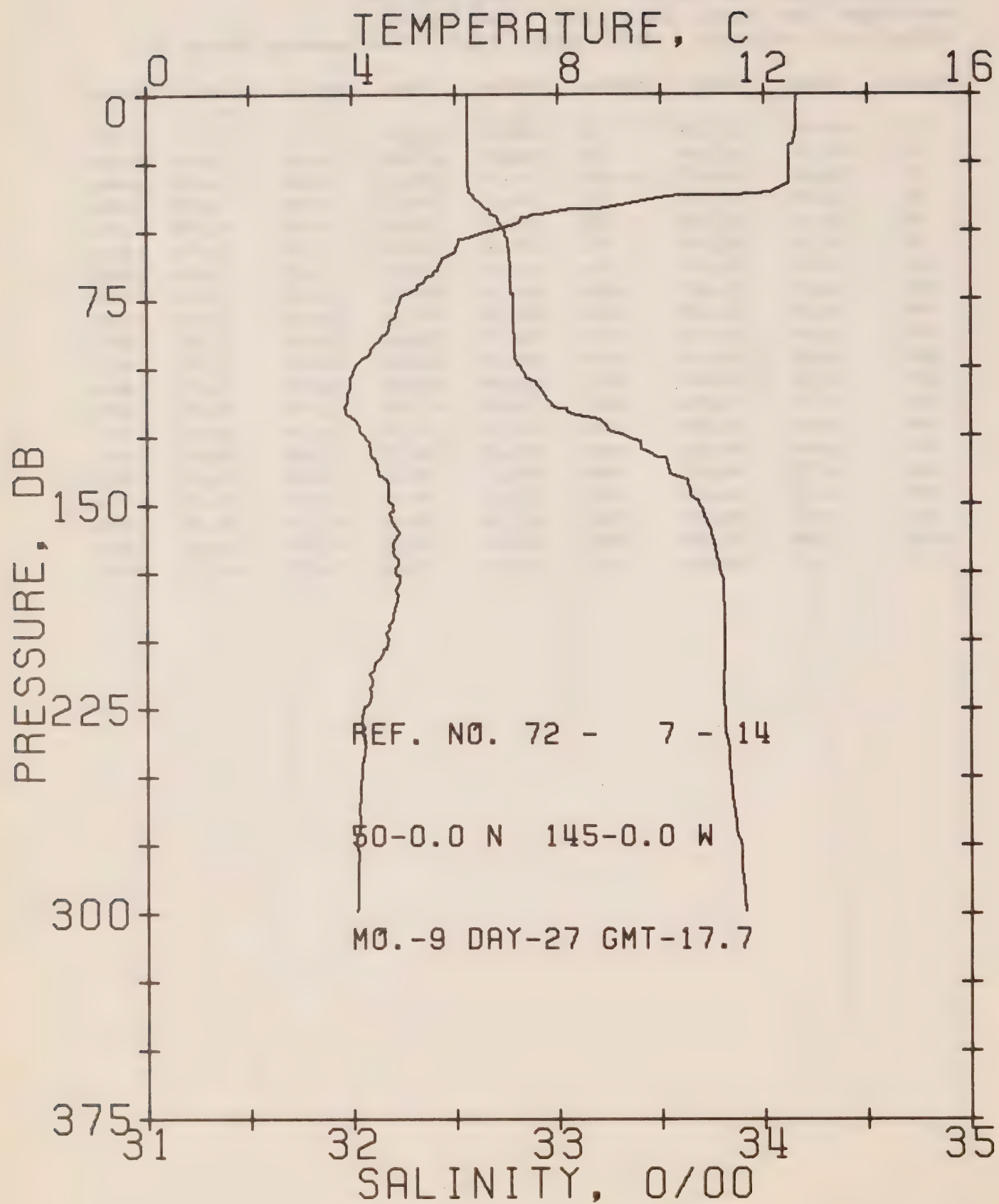
REFERENCE NO. 72- 7- 13

DATE 25/ 9/72

POSITION 50- 0.0N. 145- 0.0W GMT 23.2

RESULTS OF STP CAST 206 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	12.53	32.56	0	24.62	332.9	0.0	0.0	1496.
10	12.34	32.57	10	24.66	329.2	0.33	0.02	1496.
20	12.32	32.57	20	24.67	329.0	0.66	0.07	1496.
30	12.31	32.57	30	24.67	329.1	0.99	0.15	1496.
50	7.17	32.75	50	25.65	235.6	1.56	0.38	1478.
75	5.77	32.79	75	25.86	215.8	2.12	0.74	1472.
100	4.65	32.79	99	25.99	203.8	2.65	1.20	1468.
125	4.27	33.27	124	26.41	164.1	3.12	1.75	1468.
150	4.63	33.68	149	26.70	137.2	3.49	2.26	1470.
175	4.83	33.78	174	26.75	132.0	3.83	2.82	1472.
200	4.50	33.82	199	26.82	125.8	4.15	3.43	1471.
225	4.28	33.82	223	26.84	123.7	4.46	4.11	1470.
250	4.15	33.86	248	26.89	119.7	4.77	4.84	1470.
300	4.08	33.90	298	26.93	116.2	5.36	6.50	1471.
400	3.81	34.02	397	27.05	105.2	6.46	10.43	1471.
500	3.73	34.11	496	27.13	98.6	7.48	15.12	1473.
600	3.51	34.20	595	27.22	90.3	8.43	20.39	1474.
800	3.19	34.31	793	27.34	80.2	10.12	32.44	1476.
1000	2.89	34.38	990	27.42	73.2	11.65	46.42	1478.
1200	2.64	34.43	1188	27.49	67.5	13.05	62.12	1480.



OFFSHORE OCEANOGRAPHY GROUP

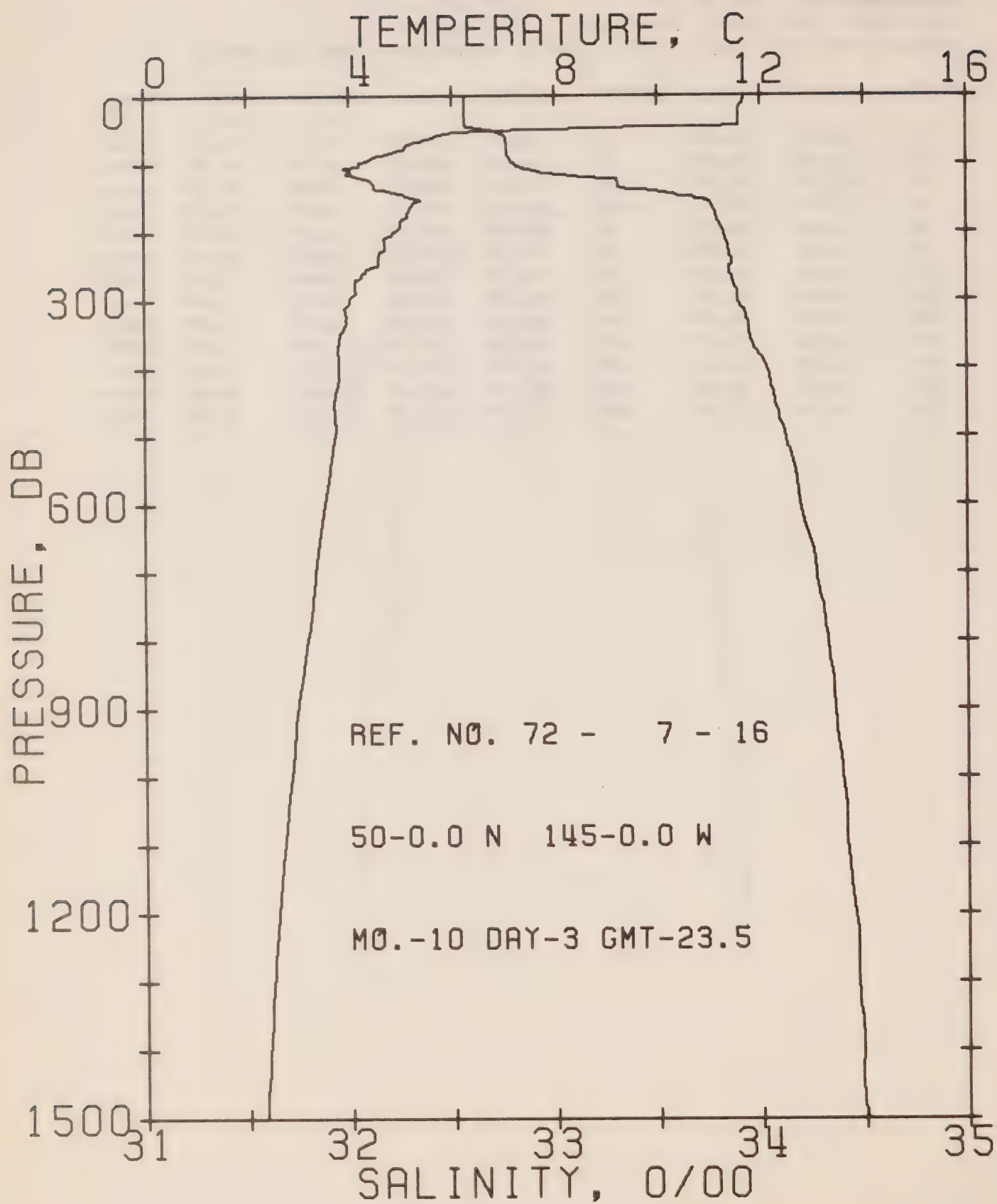
REFERENCE NO. 72- 7- 14

DATE 27/ 9/72

POSITION 50- 0.0N, 145- 0.0W GMT 17.7

RESULTS OF STP CAST 171 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	12.65	32.56	0	24.60	335.1	0.0	0.0	1497.
10	12.60	32.56	10	24.61	334.7	0.33	0.02	1497.
20	12.48	32.56	20	24.63	332.7	0.67	0.07	1496.
30	12.47	32.56	30	24.63	332.7	1.00	0.15	1497.
50	6.68	32.73	50	25.70	230.7	1.57	0.38	1476.
75	4.92	32.78	75	25.95	207.2	2.11	0.72	1469.
100	4.03	32.82	99	26.07	195.4	2.61	1.17	1466.
125	4.23	33.33	124	26.46	159.2	3.07	1.69	1468.
150	4.78	33.68	149	26.68	138.8	3.43	2.20	1471.
175	4.84	33.78	174	26.75	132.0	3.77	2.76	1472.
200	4.67	33.81	199	26.79	128.4	4.09	3.38	1471.
225	4.18	33.81	223	26.85	123.5	4.41	4.06	1470.
250	4.15	33.83	248	26.87	121.5	4.72	4.81	1470.



OFFSHORE OCEANOGRAPHY GROUP

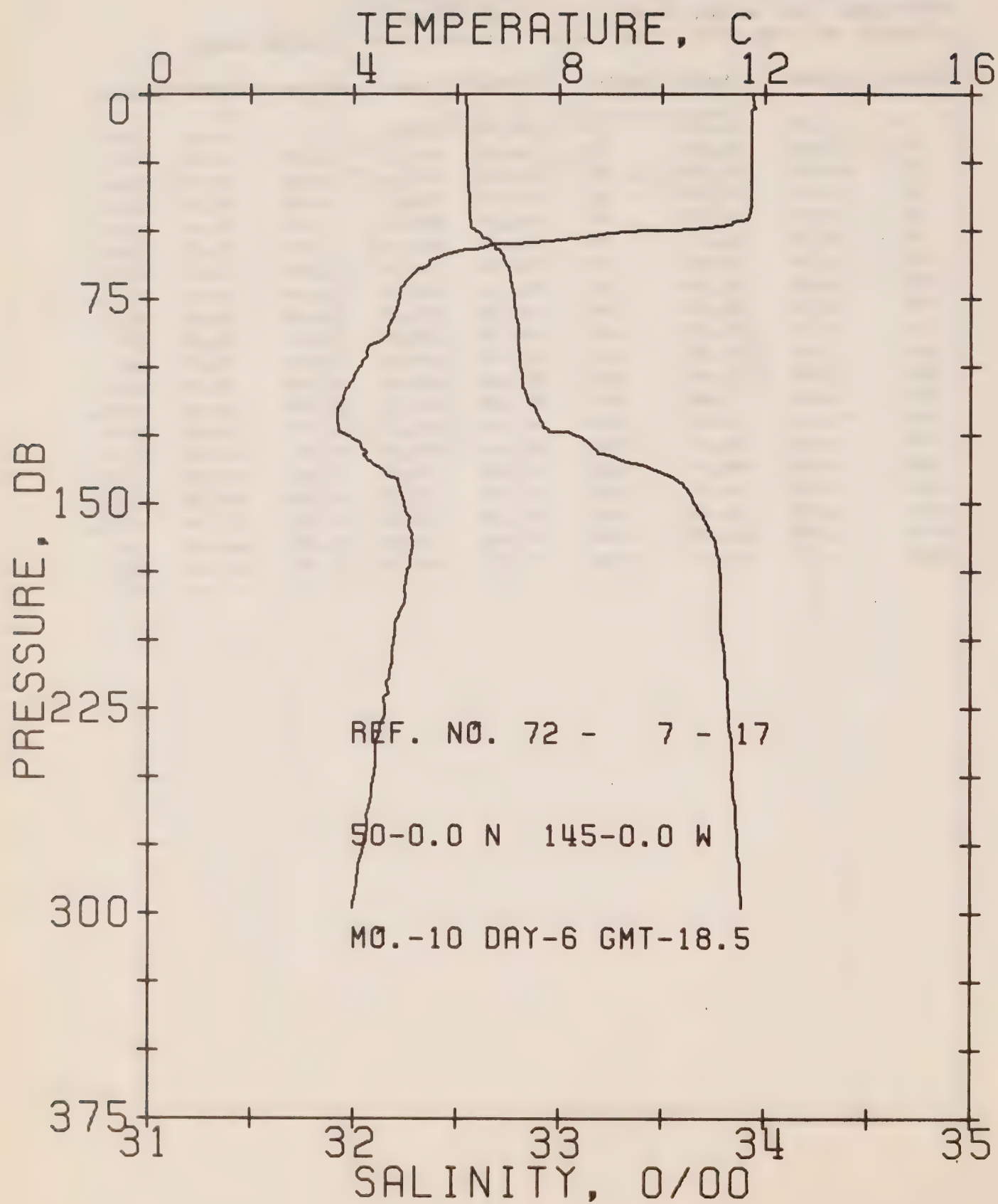
REFERENCE NO. 72- 7- 16

DATE 3/10/72

POSITION 50- 0.0N, 145- 0.0W GMT 23.5

RESULTS OF STP CAST 197 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.68	32.56	0	24.78	317.8	0.0	0.0	1493.
10	11.66	32.56	10	24.78	317.8	0.32	0.02	1493.
20	11.58	32.56	20	24.80	316.6	0.63	0.06	1493.
30	11.57	32.56	30	24.80	316.7	0.95	0.15	1493.
50	8.10	32.67	50	25.46	254.3	1.57	0.40	1481.
75	5.10	32.77	75	25.92	209.8	2.11	0.74	1470.
100	4.20	32.80	99	26.04	198.5	2.63	1.20	1466.
125	4.42	33.30	124	26.42	163.3	3.09	1.72	1468.
150	5.17	33.67	149	26.63	143.6	3.48	2.27	1472.
175	5.13	33.78	174	26.72	135.5	3.83	2.85	1473.
200	4.89	33.82	199	26.78	130.1	4.16	3.48	1472.
225	4.68	33.84	223	26.82	126.5	4.48	4.17	1472.
250	4.54	33.85	248	26.84	124.2	4.79	4.92	1472.
300	4.00	33.89	298	26.93	116.2	5.39	6.60	1470.
400	3.80	34.03	397	27.06	104.6	6.49	10.53	1471.
500	3.69	34.12	496	27.14	97.6	7.50	15.15	1473.
600	3.50	34.19	595	27.22	90.9	8.44	20.40	1473.
800	3.14	34.32	793	27.35	78.8	10.12	32.38	1475.
1000	2.83	34.39	990	27.44	71.4	11.62	46.09	1477.
1200	2.57	34.45	1188	27.51	65.4	12.99	61.46	1480.



OFFSHORE OCEANOGRAPHY GROUP

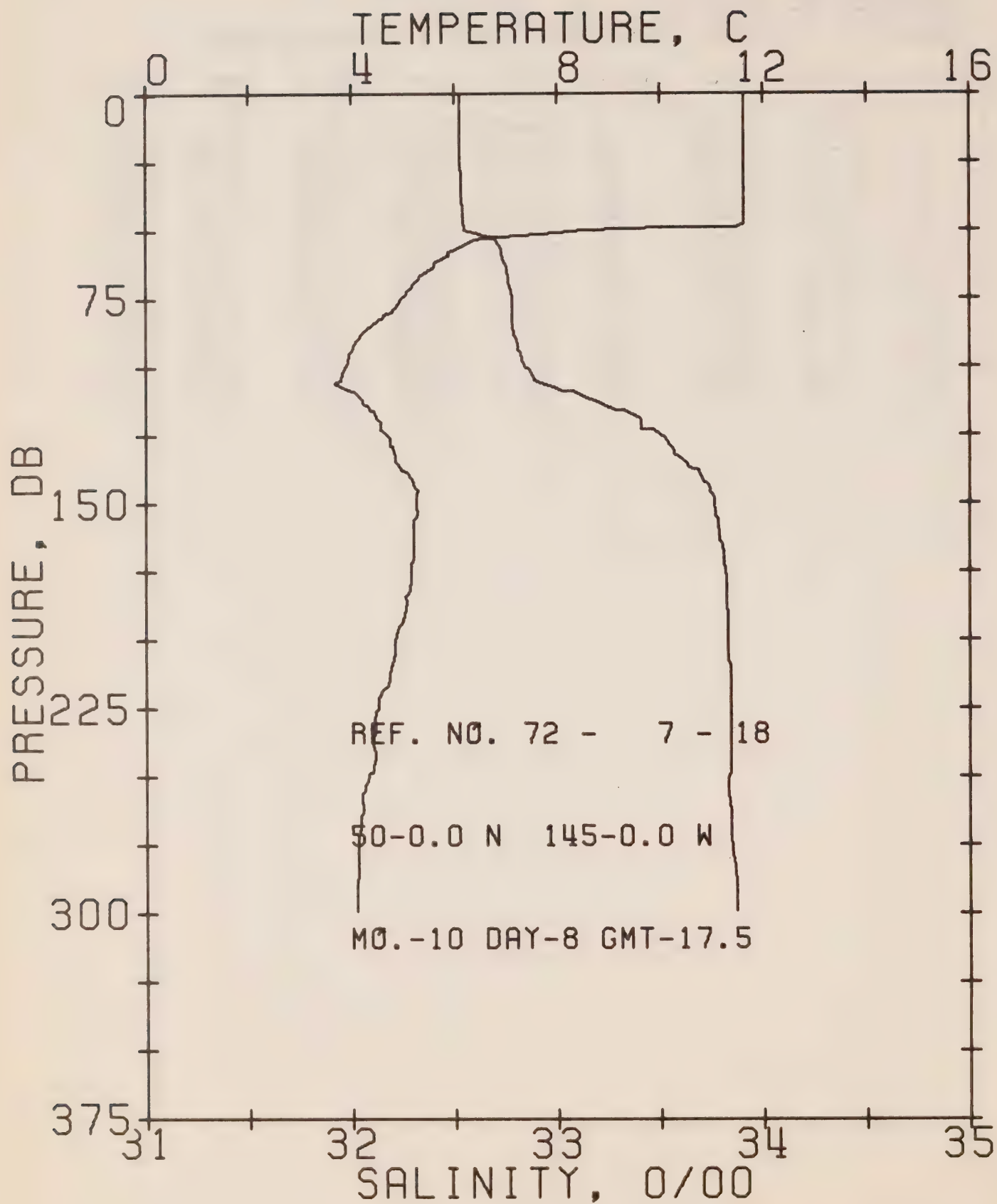
REFERENCE NO. 72- 7- 17

DATE 6/10/72

POSITION 50- 0.0N, 145- 0.0W GMT 18.5

RESULTS OF STP CAST 147 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.76	32.54	0	24.75	320.6	0.0	0.0	1494.
10	11.74	32.55	10	24.76	319.9	0.32	0.02	1494.
20	11.73	32.55	20	24.76	320.0	0.64	0.07	1494.
30	11.73	32.55	30	24.77	319.9	0.96	0.15	1494.
50	10.23	32.59	50	25.06	292.4	1.60	0.41	1489.
75	4.87	32.78	75	25.96	206.6	2.16	0.76	1469.
100	4.12	32.81	99	26.06	196.9	2.66	1.21	1466.
125	3.84	33.07	124	26.29	174.9	3.14	1.75	1466.
150	4.99	33.66	149	26.64	142.9	3.53	2.30	1472.
175	5.03	33.78	174	26.73	134.2	3.87	2.87	1472.
200	4.77	33.79	199	26.77	130.6	4.20	3.50	1472.
225	4.62	33.82	223	26.81	127.1	4.52	4.20	1472.
250	4.37	33.84	248	26.85	123.3	4.84	4.95	1471.



OFFSHORE OCEANOGRAPHY GROUP

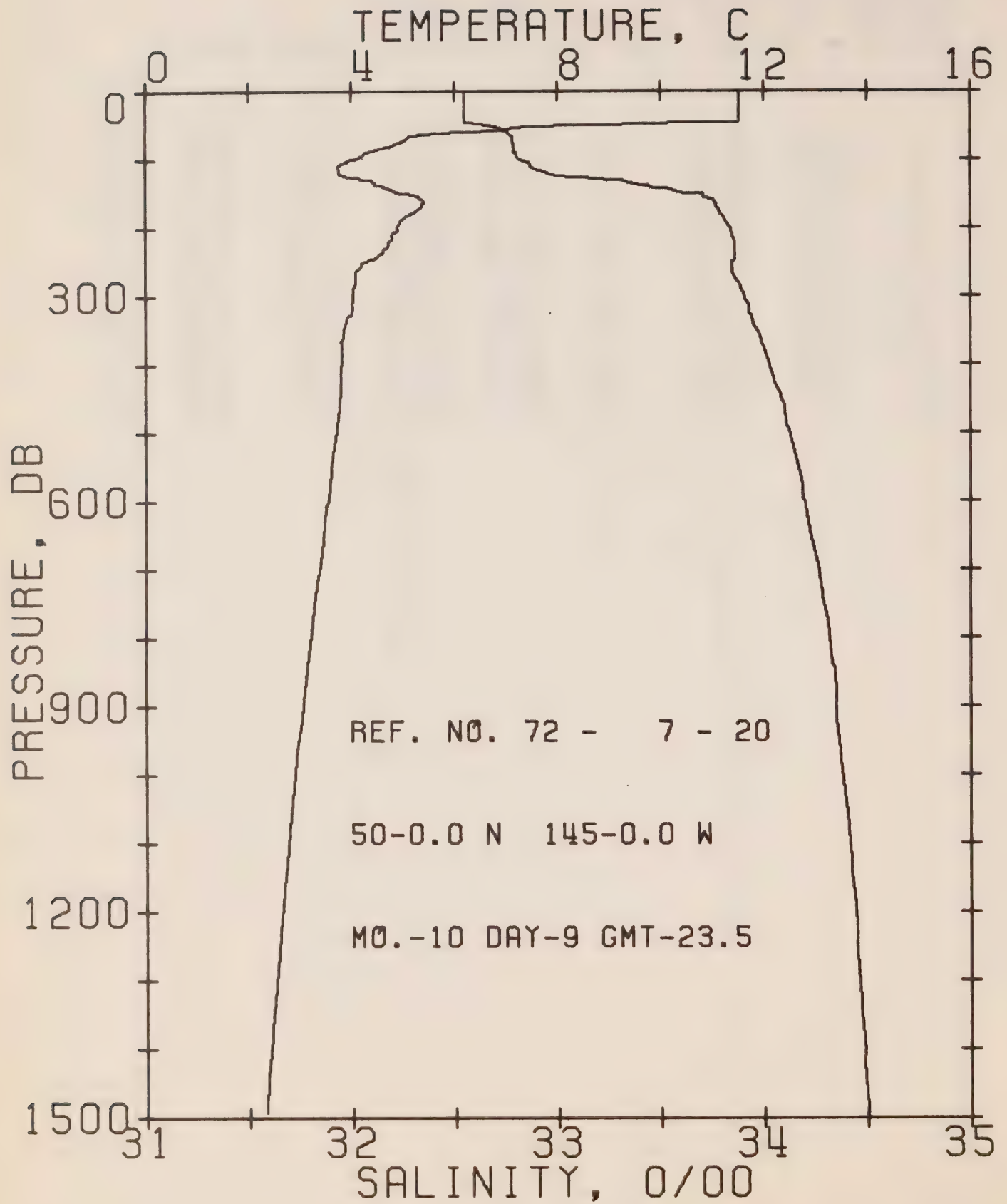
REFERENCE NO. 72- 7- 18

DATE 8/10/72

POSITION 50- 0.0N. 145- 0.0W GMT 17.5

RESULTS OF STP CAST 133 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.63	32.53	0	24.76	319.1	0.0	0.0	1493.
10	11.62	32.53	10	24.77	319.4	0.32	0.02	1493.
20	11.62	32.53	20	24.77	319.6	0.64	0.07	1493.
30	11.62	32.53	30	24.77	319.5	0.96	0.15	1494.
50	8.54	32.55	50	25.30	269.5	1.59	0.41	1483.
75	4.97	32.78	75	25.95	207.6	2.15	0.76	1469.
100	3.87	32.84	99	26.11	192.2	2.65	1.20	1465.
125	4.69	33.50	124	26.55	150.8	3.07	1.69	1470.
150	5.26	33.76	149	26.69	138.2	3.43	2.19	1473.
175	5.16	33.81	174	26.74	133.3	3.77	2.75	1473.
200	4.84	33.83	199	26.79	128.8	4.10	3.38	1472.
225	4.52	33.84	223	26.83	124.8	4.42	4.06	1471.
250	4.31	33.83	248	26.85	123.2	4.73	4.81	1471.



OFFSHORE OCEANOGRAPHY GROUP

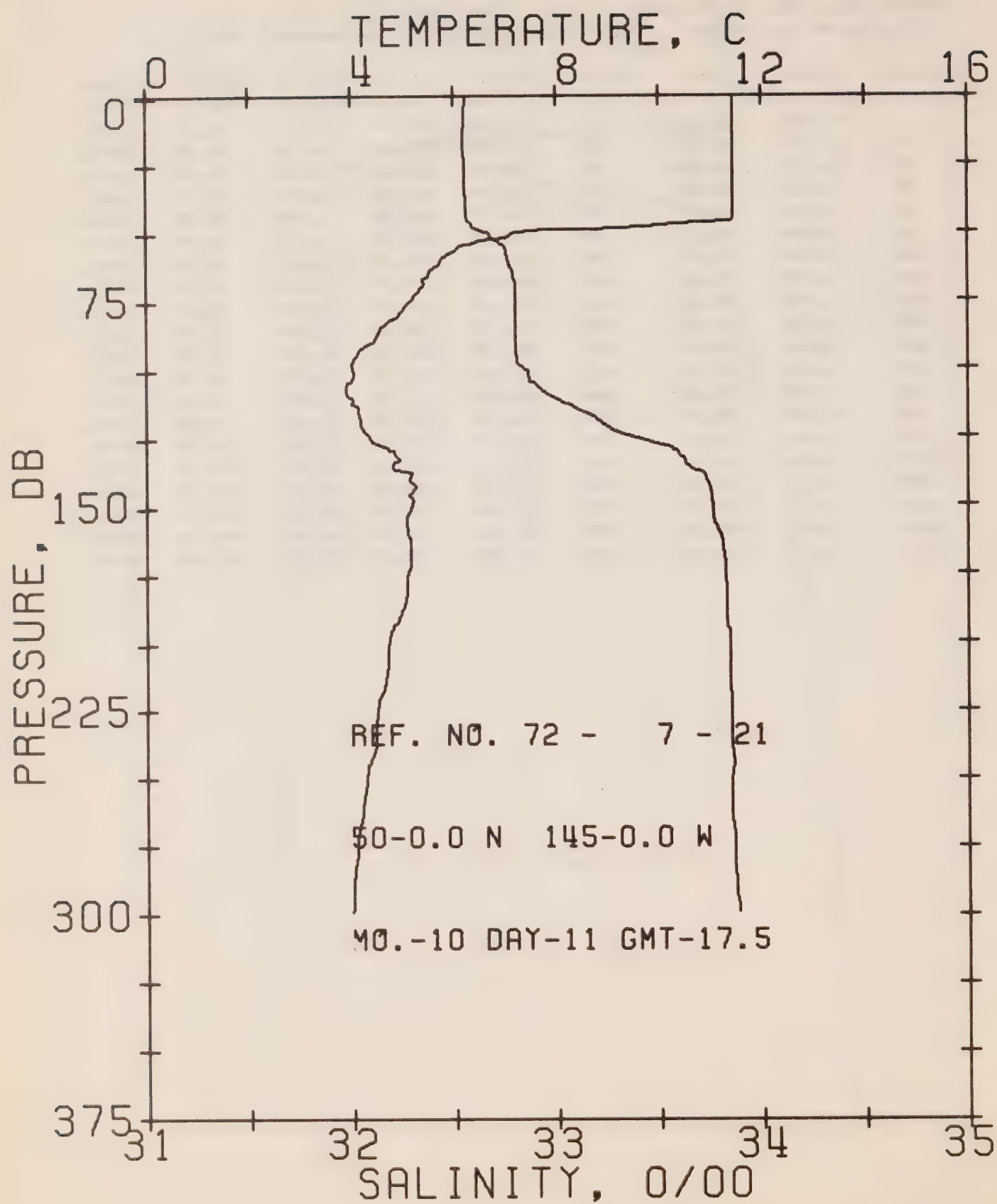
REFERENCE NO. 72- 7- 20

DATE 9/10/72

POSITION 50- 0.0N, 145- 0.0W GMT 23.5

RESULTS OF STP CAST 170 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.53	32.55	0	24.80	315.9	0.0	0.0	1493.
10	11.53	32.55	10	24.80	316.3	0.32	0.02	1493.
20	11.53	32.55	20	24.80	316.5	0.63	0.06	1493.
30	11.52	32.55	30	24.80	316.6	0.95	0.15	1493.
50	8.53	32.67	50	25.39	260.4	1.57	0.40	1483.
75	4.94	32.78	75	25.95	207.4	2.13	0.75	1469.
100	4.09	32.82	99	26.07	195.9	2.63	1.20	1466.
125	3.90	33.04	124	26.26	177.7	3.10	1.73	1466.
150	4.97	33.62	149	26.61	145.5	3.49	2.29	1471.
175	5.25	33.78	174	26.70	136.9	3.84	2.86	1473.
200	4.88	33.83	199	26.79	128.9	4.17	3.50	1472.
225	4.71	33.86	223	26.83	125.4	4.49	4.18	1472.
250	4.30	33.85	248	26.87	121.9	4.80	4.93	1471.
300	4.02	33.90	298	26.94	115.6	5.39	6.59	1470.
400	3.80	34.02	397	27.06	104.9	6.49	10.50	1471.
500	3.69	34.12	496	27.14	97.3	7.50	15.12	1473.
600	3.53	34.19	595	27.22	90.9	8.44	20.36	1474.
800	3.18	34.32	793	27.35	79.4	10.13	32.43	1476.
1000	2.88	34.38	990	27.42	73.0	11.66	46.36	1478.
1200	2.64	34.44	1188	27.50	66.7	13.05	61.99	1480.



OFFSHORE OCEANOGRAPHY GROUP

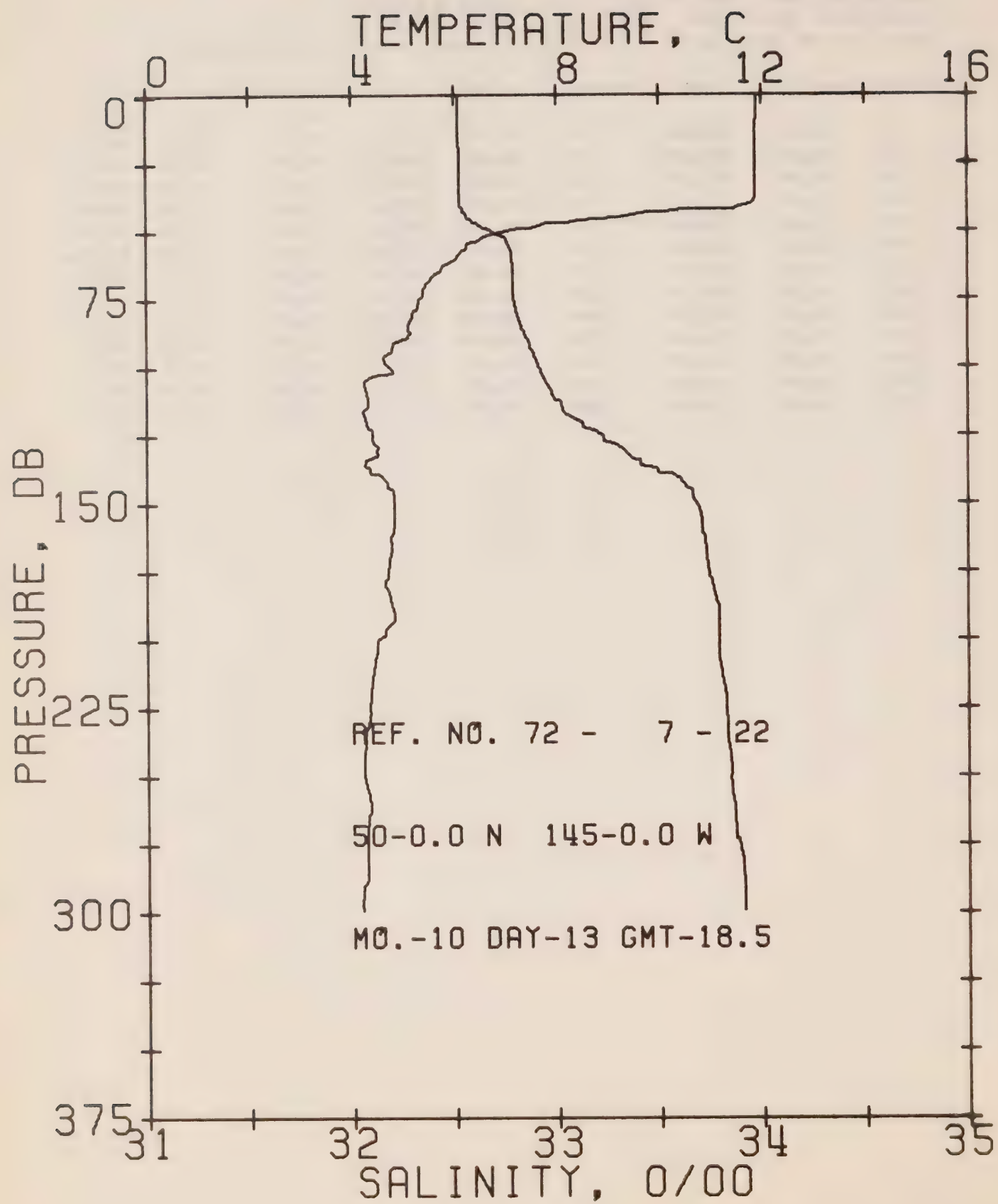
REFERENCE NO. 72- 7- 21

DATE 11/10/72

POSITION 50- 0.0N, 145- 0.0W GMT 17.5

RESULTS OF STP-CAST 120 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.44	32.56	0	24.82	313.6	0.0	0.0	1492.
10	11.44	32.55	10	24.82	314.5	0.31	0.02	1493.
20	11.44	32.55	20	24.82	314.9	0.63	0.06	1493.
30	11.44	32.55	30	24.82	314.8	0.94	0.14	1493.
50	7.26	32.64	50	25.55	245.2	1.56	0.39	1478.
75	5.16	32.80	75	25.94	208.2	2.10	0.74	1470.
100	4.02	32.84	99	26.09	193.7	2.61	1.19	1466.
125	4.36	33.37	124	26.48	157.8	3.05	1.70	1468.
150	5.18	33.76	149	26.69	137.5	3.41	2.20	1473.
175	5.08	33.82	174	26.76	132.0	3.75	2.75	1473.
200	4.70	33.84	199	26.81	126.5	4.07	3.37	1471.
225	4.49	33.85	223	26.85	123.7	4.38	4.05	1471.
250	4.28	33.85	248	26.87	121.6	4.69	4.79	1471.



OFFSHORE OCEANOGRAPHY GROUP

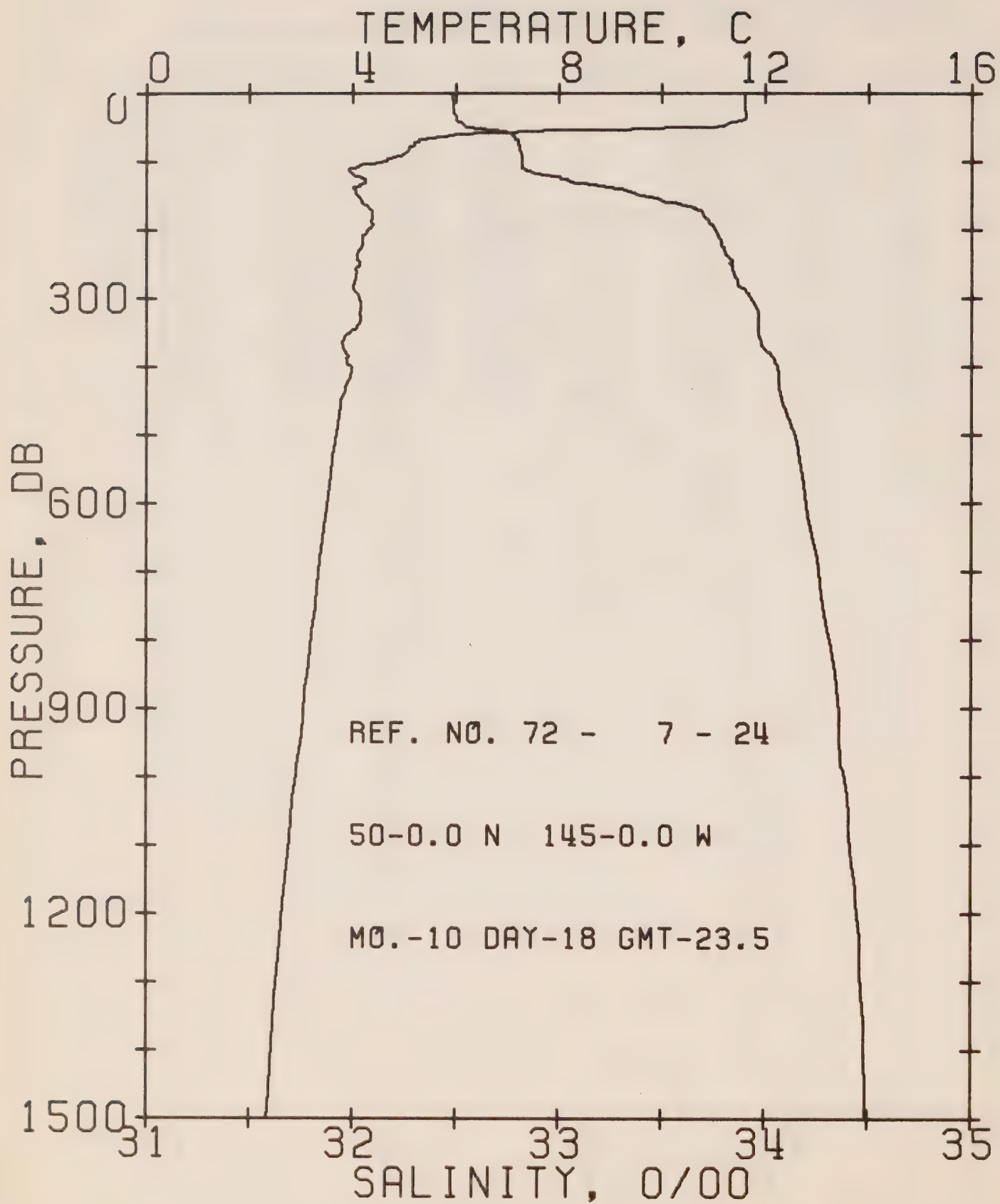
REFERENCE NO. 72- 7- 22

DATE 13/10/72

POSITION 50- 0.0N, 145- 0.0W, GMT 18.5

RESULTS OF STP CAST - 147 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	11.89	32.52	0	24.71	324.4	0.0	0.0	1494.
10	11.88	32.52	10	24.71	324.7	0.32	0.02	1494.
20	11.87	32.53	20	24.72	324.1	0.65	0.07	1494.
30	11.86	32.53	30	24.72	324.0	0.97	0.15	1494.
50	7.03	32.69	50	25.61	239.2	1.58	0.39	1477.
75	5.30	32.79	75	25.92	210.5	2.12	0.74	1471.
100	4.75	32.91	99	26.07	195.8	2.63	1.19	1469.
125	4.40	33.23	124	26.36	168.3	3.09	1.71	1468.
150	4.83	33.68	149	26.67	139.4	3.47	2.24	1471.
175	4.70	33.74	174	26.73	133.9	3.81	2.81	1471.
200	4.48	33.79	199	26.80	127.9	4.14	3.44	1471.
225	4.33	33.82	223	26.84	124.3	4.45	4.12	1470.
250	4.22	33.84	248	26.87	121.5	4.76	4.86	1470.



OFFSHORE OCEANOGRAPHY GROUP

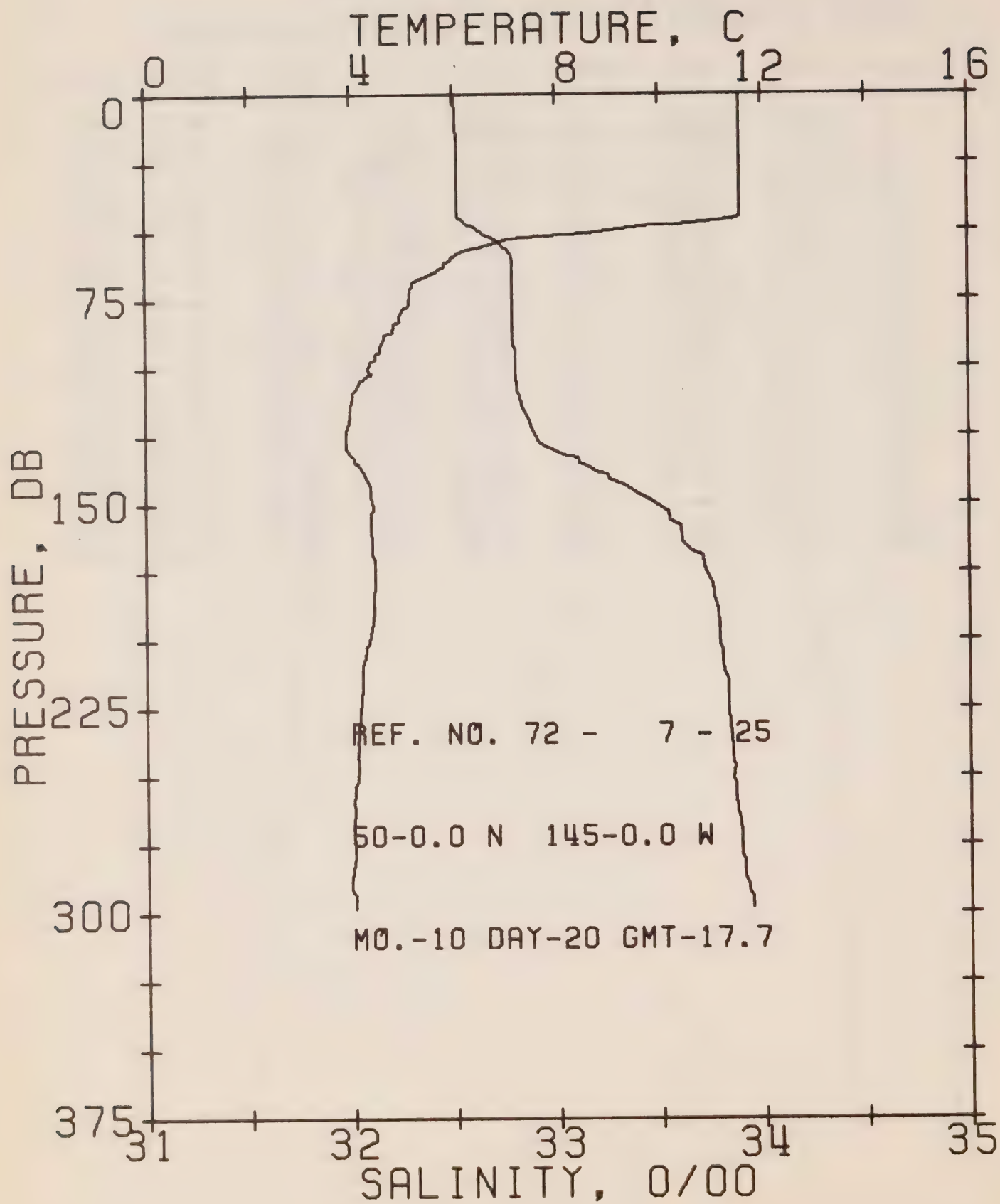
REFERENCE NO. 72- 7- 24

DATE 18/10/72

POSITION 50- 0.0N. 145- 0.0W GMT 23.5

RESULTS OF STP CAST 191 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.61	32.48	0	24.73	322.4	0.0	0.0	1493.
10	11.61	32.48	10	24.73	322.6	0.32	0.02	1493.
20	11.61	32.49	20	24.74	322.4	0.64	0.07	1493.
30	11.62	32.49	30	24.73	322.8	0.97	0.15	1493.
50	10.96	32.55	50	24.90	307.4	1.60	0.41	1492.
75	5.21	32.80	75	25.93	208.8	2.18	0.77	1470.
100	4.63	32.82	99	26.01	201.3	2.69	1.23	1468.
125	4.25	33.01	124	26.20	183.4	3.17	1.78	1467.
150	4.10	33.39	149	26.52	153.5	3.59	2.36	1468.
175	4.38	33.69	174	26.73	133.7	3.95	2.95	1470.
200	4.29	33.75	199	26.79	128.9	4.28	3.58	1470.
225	4.17	33.79	223	26.83	124.5	4.59	4.26	1470.
250	4.12	33.83	248	26.87	121.6	4.90	5.00	1470.
300	4.13	33.92	298	26.94	115.2	5.49	6.65	1471.
400	3.97	34.06	397	27.07	104.0	6.58	10.55	1472.
500	3.68	34.14	496	27.16	95.6	7.59	15.15	1473.
600	3.51	34.20	595	27.22	90.3	8.51	20.33	1474.
800	3.19	34.31	793	27.34	80.2	10.21	32.44	1476.
1000	2.89	34.38	990	27.43	72.8	11.74	46.37	1478.
1200	2.63	34.45	1188	27.50	66.5	13.12	61.91	1480.



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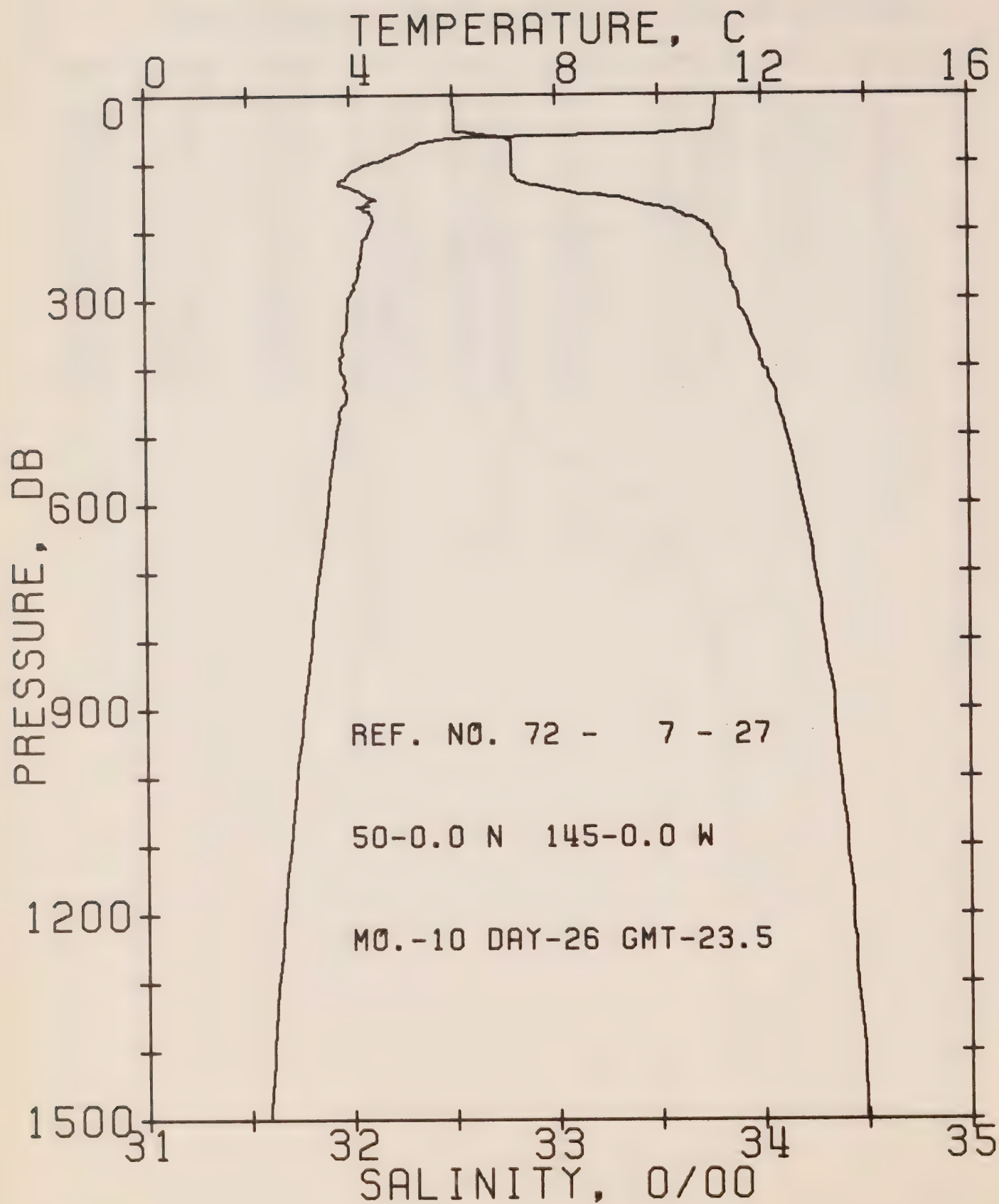
REFERENCE NO. 72- 7- 25

DATE 20/10/72

POSITION 50- 0.0N. 145- 0.0W GMT 17.7

RESULTS OF STP CAST - 125 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.57	32.51	0	24.76	319.5	0.0	0.0	1493.
10	11.57	32.52	10	24.76	319.6	0.32	0.02	1493.
20	11.57	32.52	20	24.77	319.4	0.64	0.07	1493.
30	11.57	32.52	30	24.77	319.7	0.96	0.15	1493.
50	9.04	32.62	50	25.28	271.4	1.59	0.40	1485.
75	5.16	32.79	75	25.93	208.9	2.14	0.75	1470.
100	4.33	32.80	99	26.03	199.7	2.65	1.21	1467.
125	3.89	32.89	124	26.15	188.5	3.14	1.76	1466.
150	4.42	33.48	149	26.56	150.0	3.56	2.36	1469.
175	4.45	33.72	174	26.75	132.6	3.91	2.94	1470.
200	4.33	33.79	199	26.81	126.3	4.23	3.55	1470.
225	4.14	33.83	223	26.87	121.5	4.54	4.22	1470.
250	4.08	33.85	248	26.89	119.5	4.84	4.95	1470.



OFFSHORE OCEANOGRAPHY GROUP

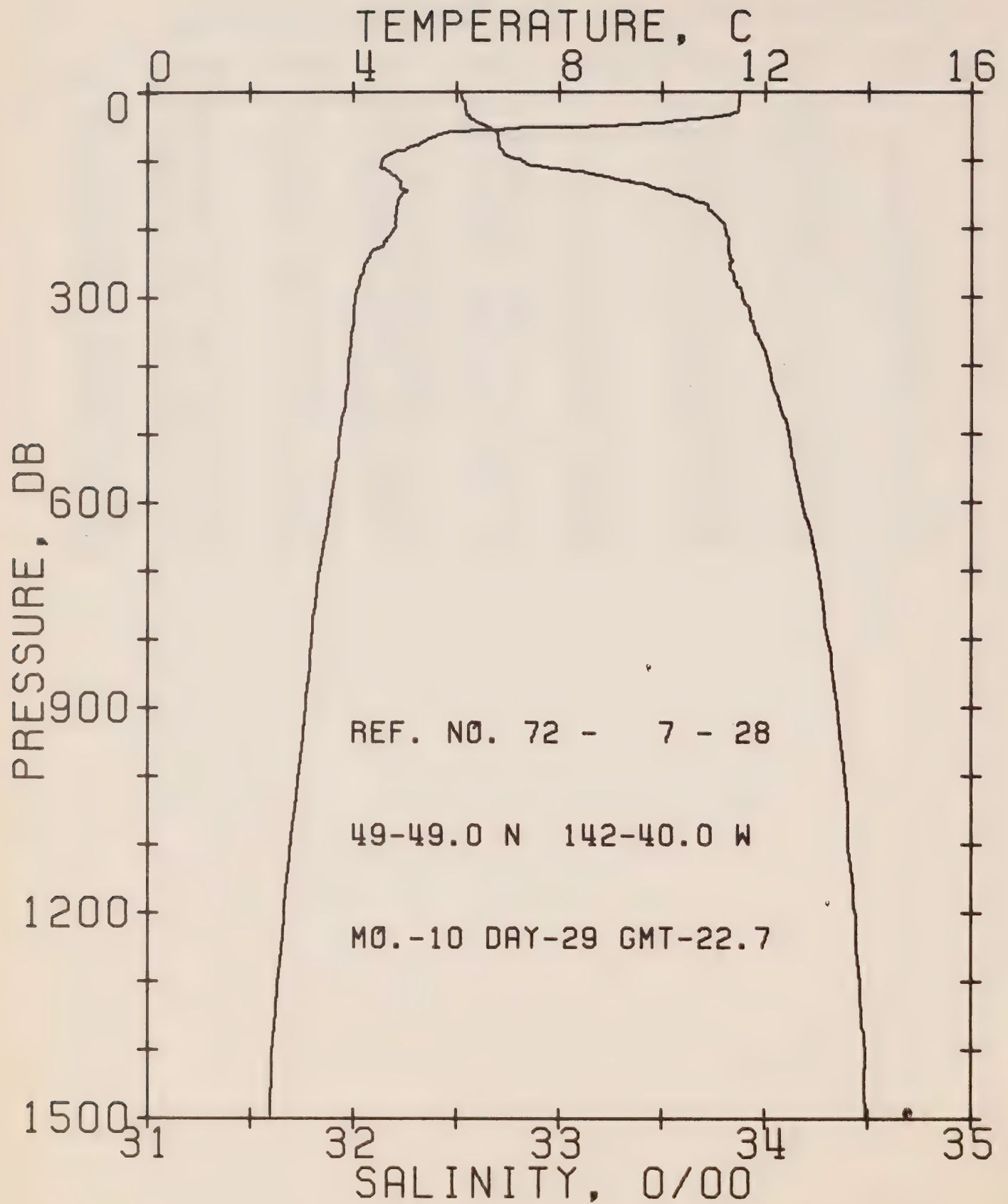
REFERENCE NO. 72- 7- 27

DATE 26/10/72

POSITION 50- 0.0N. 145- 0.0W GMT 23.5

RESULTS OF STD CAST 175 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.12	32.50	0	24.83	312.6	0.0	0.0	1491.
10	11.11	32.50	10	24.84	312.6	0.31	0.02	1491.
20	11.10	32.51	20	24.84	312.4	0.63	0.06	1491.
30	11.09	32.51	30	24.85	312.1	0.94	0.14	1492.
50	11.04	32.51	50	24.86	311.7	1.56	0.40	1492.
75	5.27	32.79	75	25.92	210.1	2.18	0.79	1470.
100	4.38	32.79	99	26.02	201.0	2.70	1.25	1467.
125	3.80	32.82	124	26.10	193.3	3.20	1.81	1465.
150	4.34	33.30	149	26.43	162.7	3.65	2.45	1468.
175	4.39	33.61	174	26.67	139.8	4.03	3.07	1469.
200	4.35	33.75	199	26.78	129.4	4.35	3.71	1470.
225	4.22	33.80	223	26.83	124.8	4.68	4.40	1470.
250	4.18	33.83	248	26.86	122.1	4.99	5.15	1470.
300	3.95	33.89	298	26.93	115.7	5.59	6.82	1470.
400	3.79	34.00	397	27.04	106.6	6.70	10.77	1471.
500	3.71	34.12	496	27.14	97.7	7.72	15.45	1473.
600	3.53	34.19	595	27.21	91.3	8.66	20.72	1474.
800	3.20	34.29	793	27.33	81.4	10.37	32.92	1476.
1000	2.90	34.37	990	27.42	73.7	11.92	47.07	1478.
1200	2.64	34.43	1188	27.49	67.7	13.33	62.86	1480.



OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 7- 28

DATE 29/10/72

POSITION 49-49.0N, 142-40.0W GMT 22.7

RESULTS OF STP CAST 187 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	11.54	32.52	0	24.77	318.2	0.0	0.0	1493.
10	11.48	32.52	10	24.79	317.3	0.32	0.02	1493.
20	11.48	32.54	20	24.80	316.4	0.63	0.06	1493.
30	11.45	32.55	30	24.81	315.4	0.95	0.15	1493.
50	8.87	32.65	50	25.32	266.9	1.55	0.39	1484.
75	5.28	32.71	75	25.86	216.3	2.12	0.75	1470.
100	4.54	32.81	99	26.02	200.9	2.64	1.22	1468.
125	4.84	33.25	124	26.33	171.5	3.11	1.75	1470.
150	4.94	33.56	149	26.57	149.6	3.51	2.31	1471.
175	4.82	33.73	174	26.71	135.8	3.86	2.89	1471.
200	4.78	33.80	199	26.77	130.4	4.19	3.53	1472.
225	4.58	33.82	223	26.81	126.9	4.52	4.22	1471.
250	4.21	33.83	248	26.86	122.4	4.83	4.97	1470.
300	4.03	33.89	298	26.93	116.5	5.42	6.65	1470.
400	3.90	34.02	397	27.04	106.5	6.54	10.62	1472.
500	3.74	34.11	496	27.13	98.4	7.57	15.32	1473.
600	3.53	34.18	595	27.21	92.0	8.52	20.66	1474.
800	3.17	34.30	793	27.34	80.6	10.23	32.82	1475.
1000	2.91	34.38	990	27.43	72.9	11.76	46.85	1478.
1200	2.64	34.44	1188	27.49	67.2	13.16	62.56	1480.

SURFACE TEMPERATURE AND SALINITY OBSERVATIONS

(P-72-7)

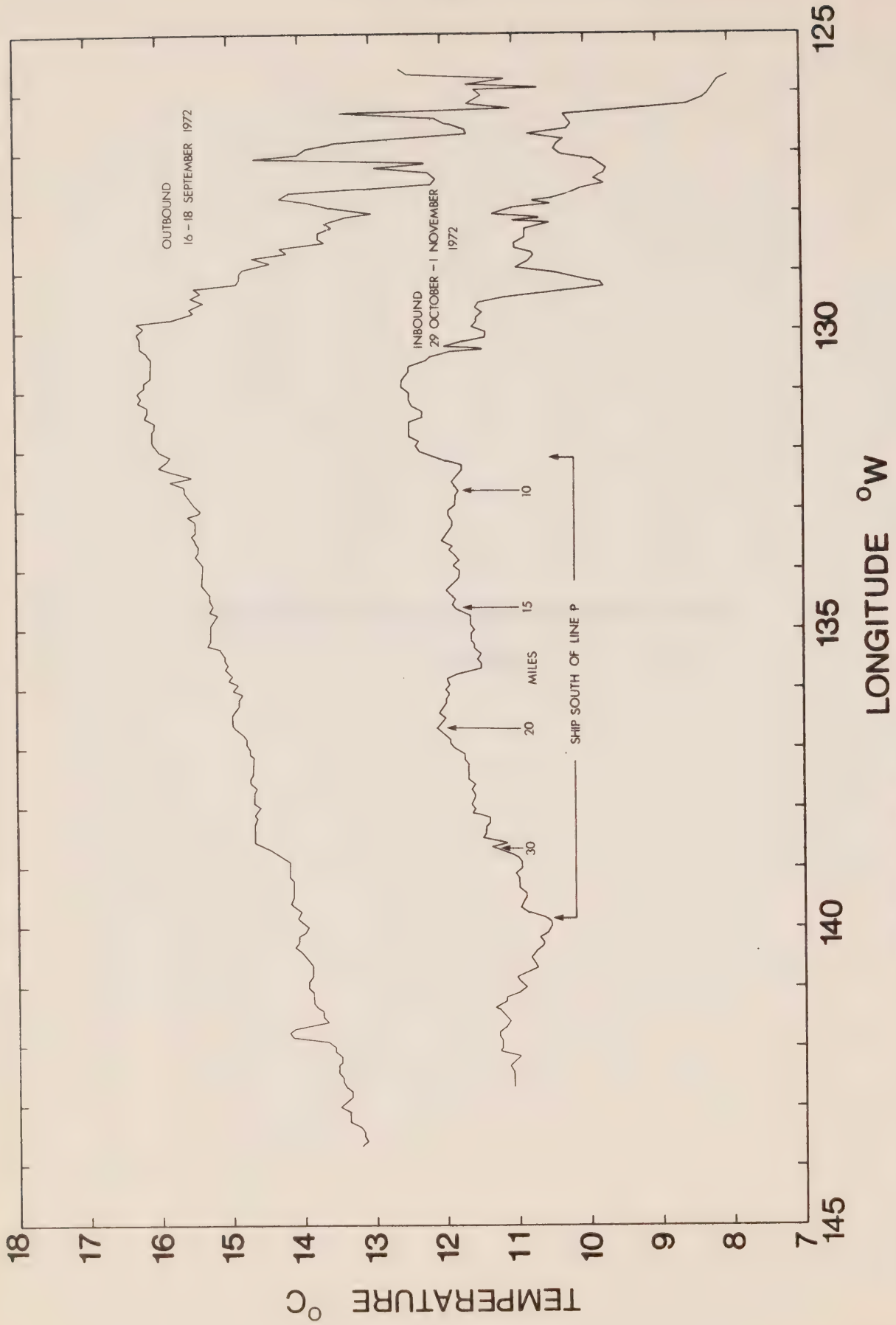


FIGURE 7 GRAPH OF LINE P SURFACE TEMPERATURES AS CONTINUOUSLY RECORDED FROM A PROBE LOCATED AT THE ENGINE ROOM INTAKE (APPROXIMATELY 3 METERS BELOW THE SURFACE), P-72-7.

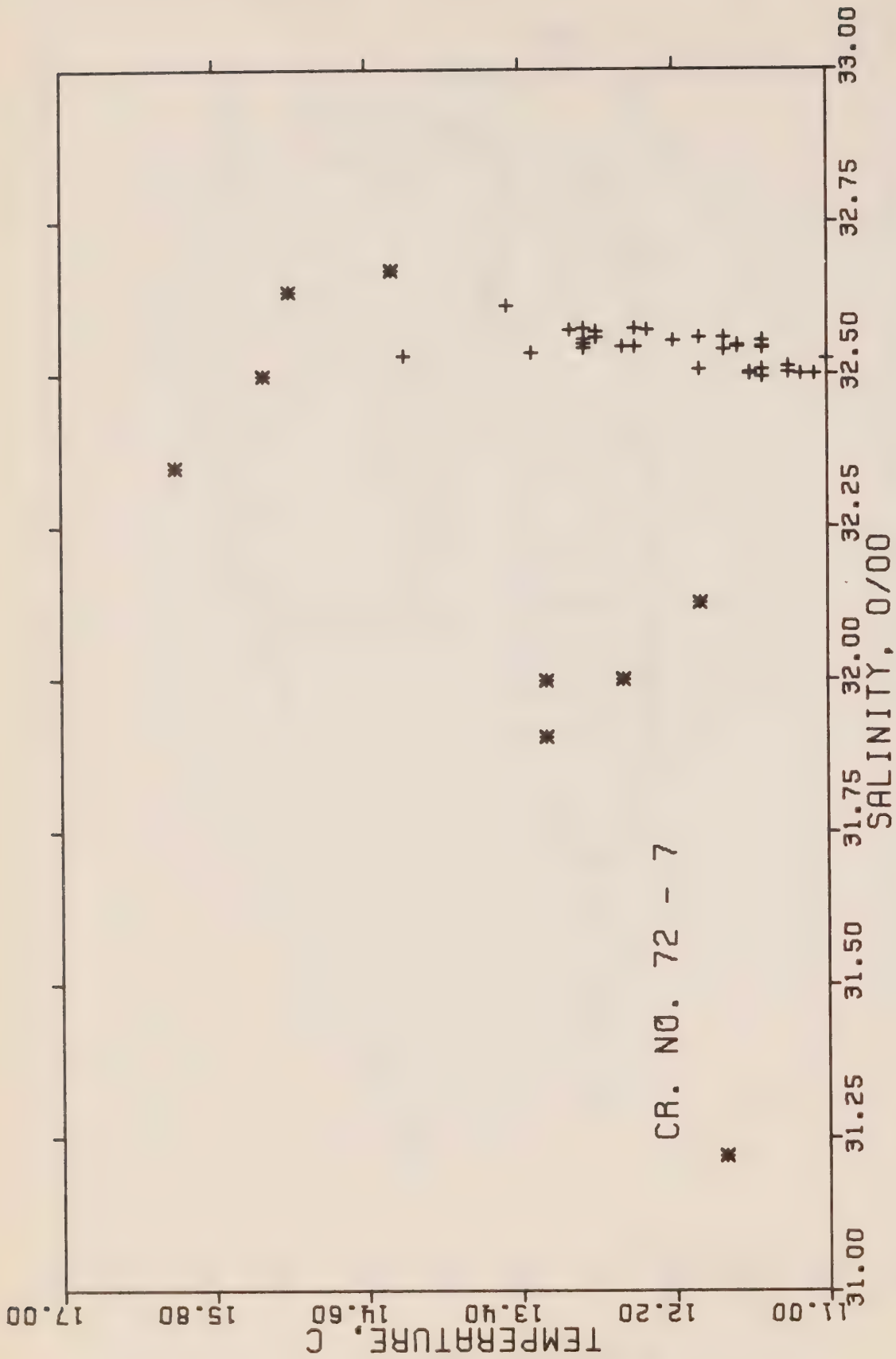


Figure 8 T-S plot of surface temperature and salinity observations on Line P (asterisks) and at Station P (pluses). P-72-7.

SURFACE SALINITY AND TEMPERATURE OBSERVATIONS
CRUISE REFERENCE NUMBER 72- 7

DATE/TIME				SALINITY	TEMP	LONGITUDE
YR	MO	DAY	GMT	0/00	C	WEST
72	9	16	2300	32.000	12.6	125-33
72	9	16	100	31.220	11.8	126- 0
72	9	16	330	32.124	12.0	126-40
72	9	16	700	31.997	13.2	127-40
72	9	16	1055	31.905	13.2	128-40
72	9	16	1745	32.348	16.1	130-40
72	9	17	100	32.498	15.4	132-40
72	9	17	800	32.636	15.2	134-40
72	9	17	1410	33.335	14.7	136-40
72	9	17	2015	32.669	14.4	138-40
72	9	18	250	0.0	14.4	140-40
72	9	18	1020	32.531	14.3	142-40
72	9	19	0	32.613	13.5	145- 0
72	9	20	0	32.535	13.3	ON STATION
72	9	21	0	32.545	12.6	ON STATION
72	9	22	0	32.558	12.9	ON STATION
72	9	23	0	32.575	12.9	ON STATION
72	9	24	0	32.572	12.4	ON STATION
72	9	25	0	32.575	12.5	ON STATION
72	9	26	0	32.573	13.0	ON STATION
72	9	27	0	32.570	12.8	ON STATION
72	9	28	0	32.560	12.8	ON STATION
72	9	29	0	32.549	12.9	ON STATION
72	9	30	0	0.0	12.7	ON STATION
72	10	1	0	0.0	12.8	ON STATION
72	10	2	0	32.542	12.9	ON STATION
72	10	3	0	32.544	12.5	ON STATION
72	10	4	0	32.560	11.8	ON STATION
72	10	5	0	32.560	12.0	ON STATION
72	10	6	0	32.554	12.2	ON STATION
72	10	7	0	32.547	11.7	ON STATION
72	10	8	0	32.541	11.8	ON STATION
72	10	9	0	32.555	11.5	ON STATION
72	10	10	0	32.544	11.5	ON STATION
72	10	11	0	32.542	11.5	ON STATION
72	10	12	0	32.545	11.7	ON STATION
72	10	13	0	32.508	12.0	ON STATION
72	10	18	0	32.545	11.7	ON STATION
72	10	19	0	32.502	11.6	ON STATION
72	10	20	0	32.502	11.6	ON STATION
72	10	21	0	32.507	11.5	ON STATION
72	10	22	0	32.499	11.6	ON STATION
72	10	23	0	32.503	11.3	ON STATION
72	10	24	0	32.513	11.3	ON STATION
72	10	25	0	32.496	11.5	ON STATION

SURFACE SALINITY AND TEMPERATURE OBSERVATIONS
 CRUISE REFERENCE NUMBER 72- 7

DATE/TIME				SALINITY	TEMP	LONGITUDE
YR	MO	DY	GMT	0/00	C	WEST
72	10	25	0	32.496	11.5	CN STATION
72	10	26	0	32.524	11.0	ON STATION
72	10	27	0	32.500	11.1	ON STATION
72	10	28	0	32.501	11.2	CN STATION

OCEANOGRAPHIC DATA OBTAINED ON CRUISE P-72-8
(CODC REFERENCE NO. 15-72-008)

SURFACE TEMPERATURE OBSERVATIONS

(P-72-8)

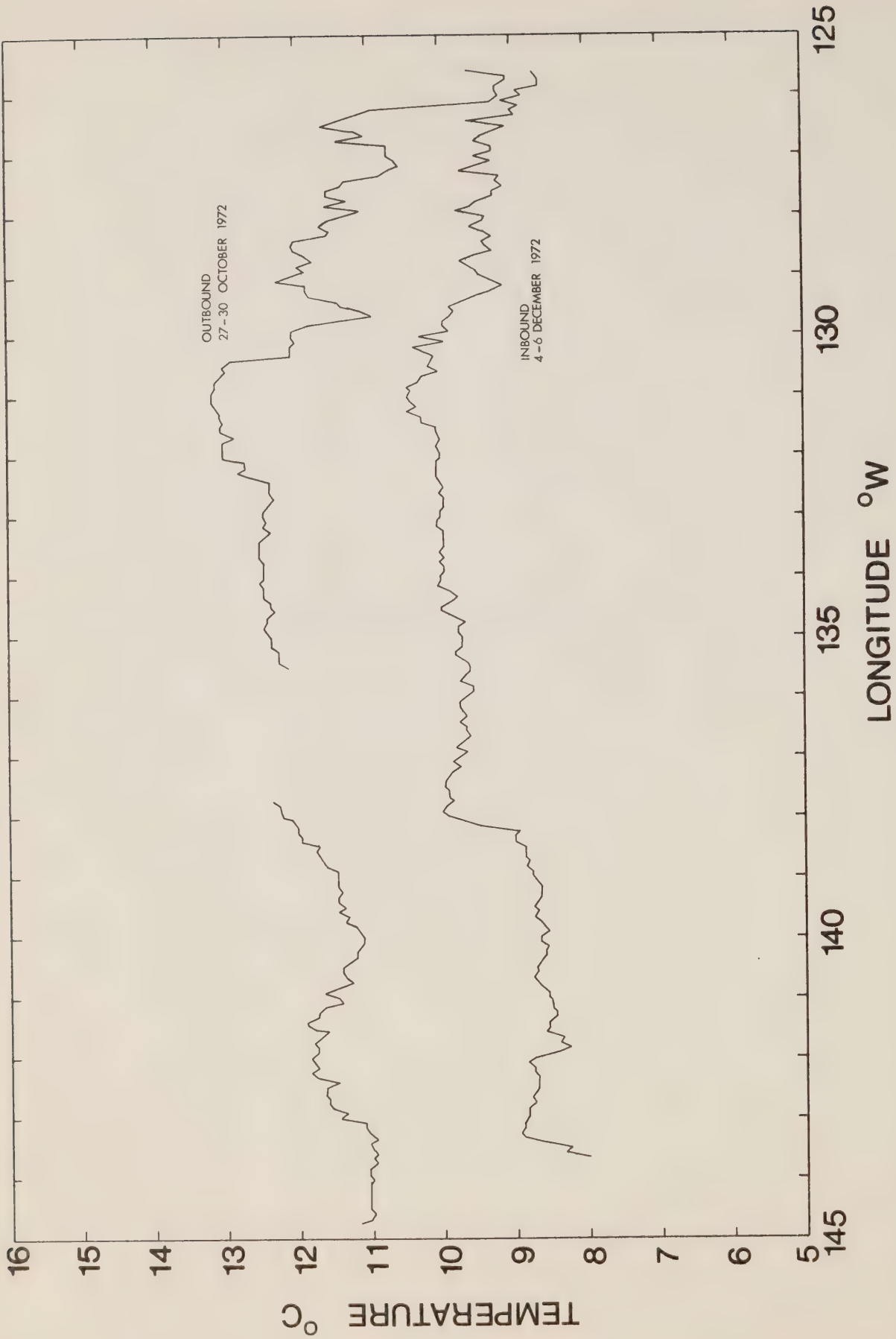


FIGURE 9 GRAPH OF LINE P SURFACE TEMPERATURES AS CONTINUOUSLY
 RECORDED FROM A PROBE LOCATED AT THE ENGINE ROOM
 INTAKE (APPROXIMATELY 3 METERS BELOW THE SURFACE).
 P-72-8.

OCEANOGRAPHIC DATA OBTAINED ON CRUISE P-72-9
(CODC REFERENCE NO. 15-72-009)

RESULTS OF BOTTLE CASTS

(P-72-9)

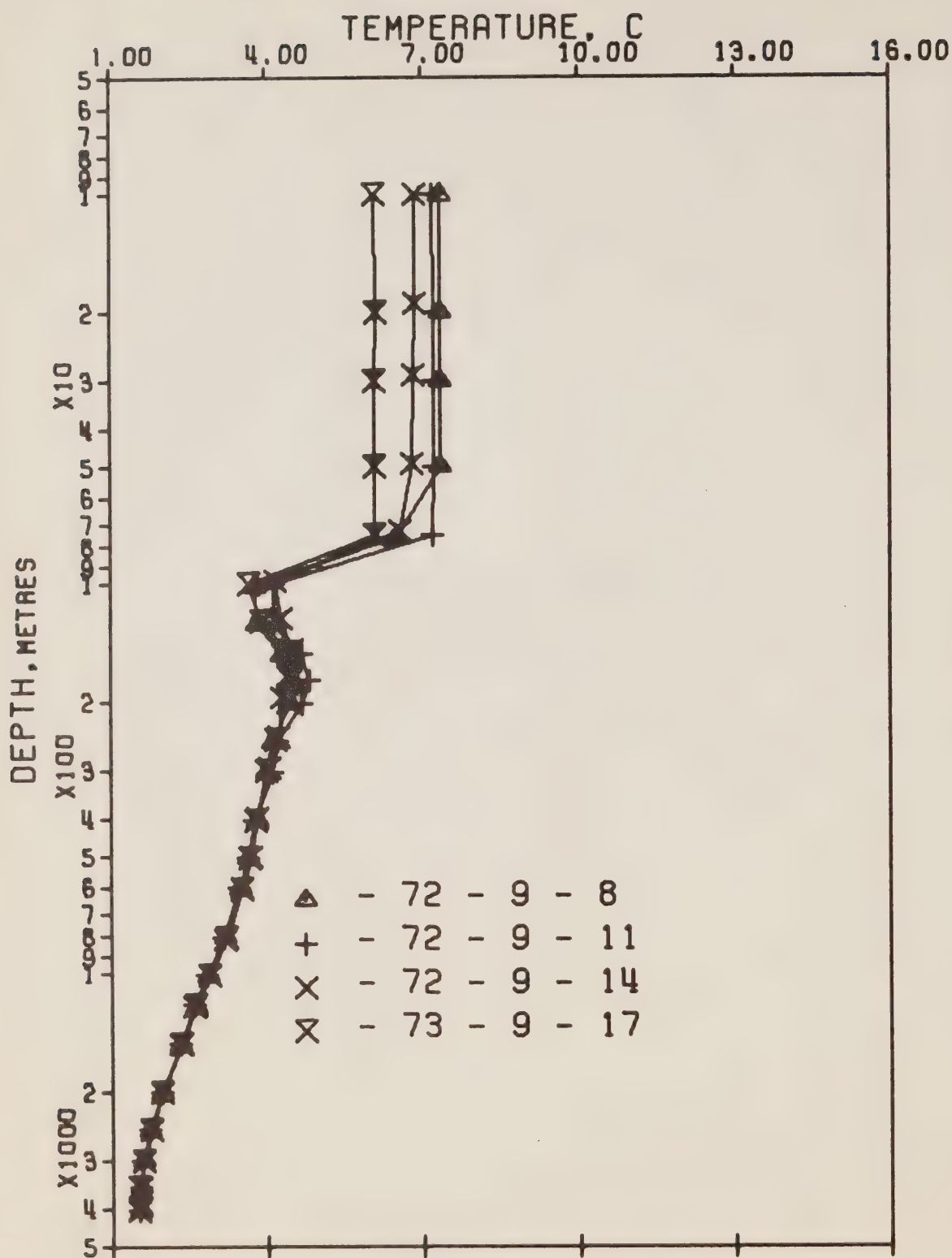


Figure 10 Composite plot of temperature vs \log_{10} depth. P-72-9.

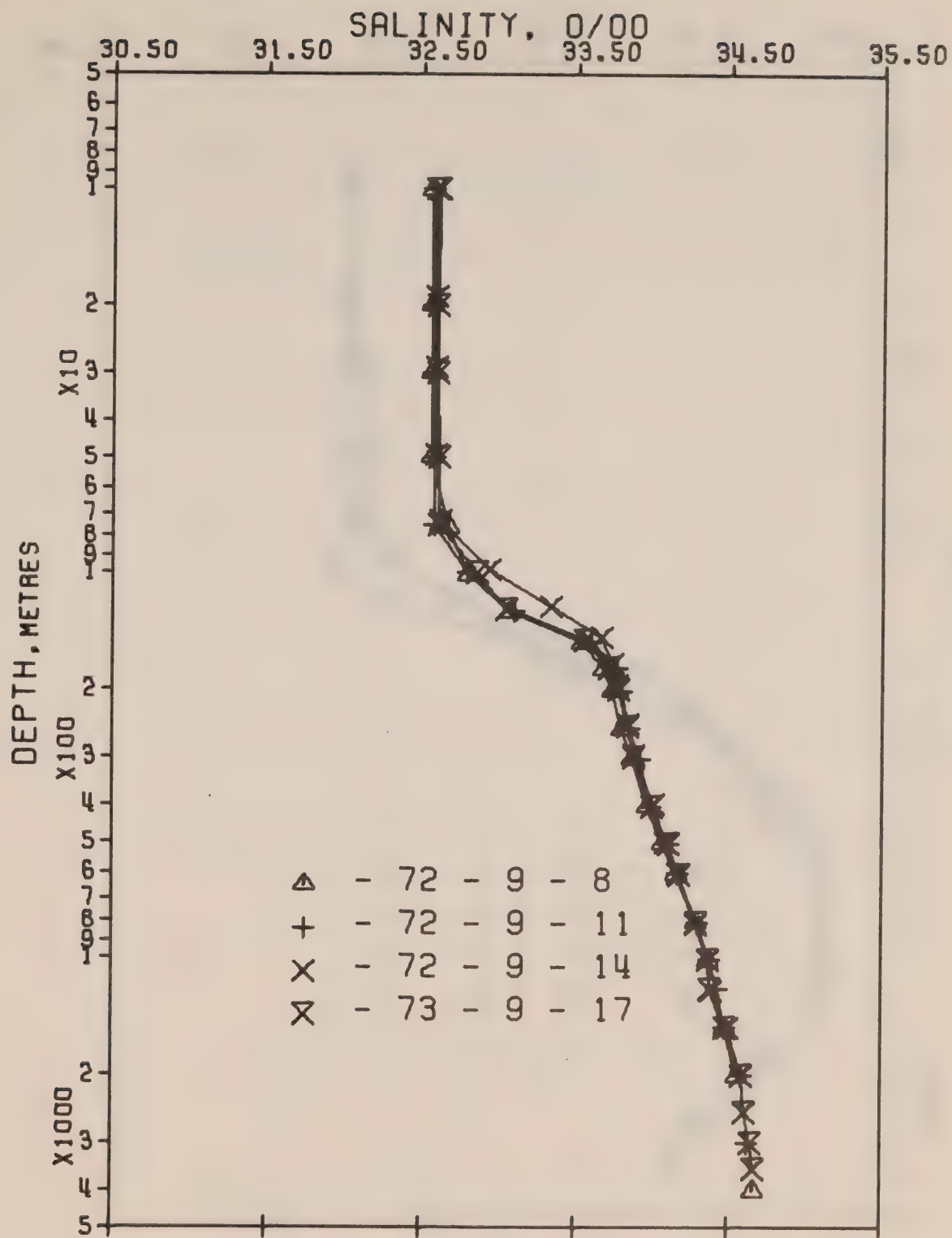


Figure 11 Composite plot of salinity vs \log_{10} depth. P-72-9.

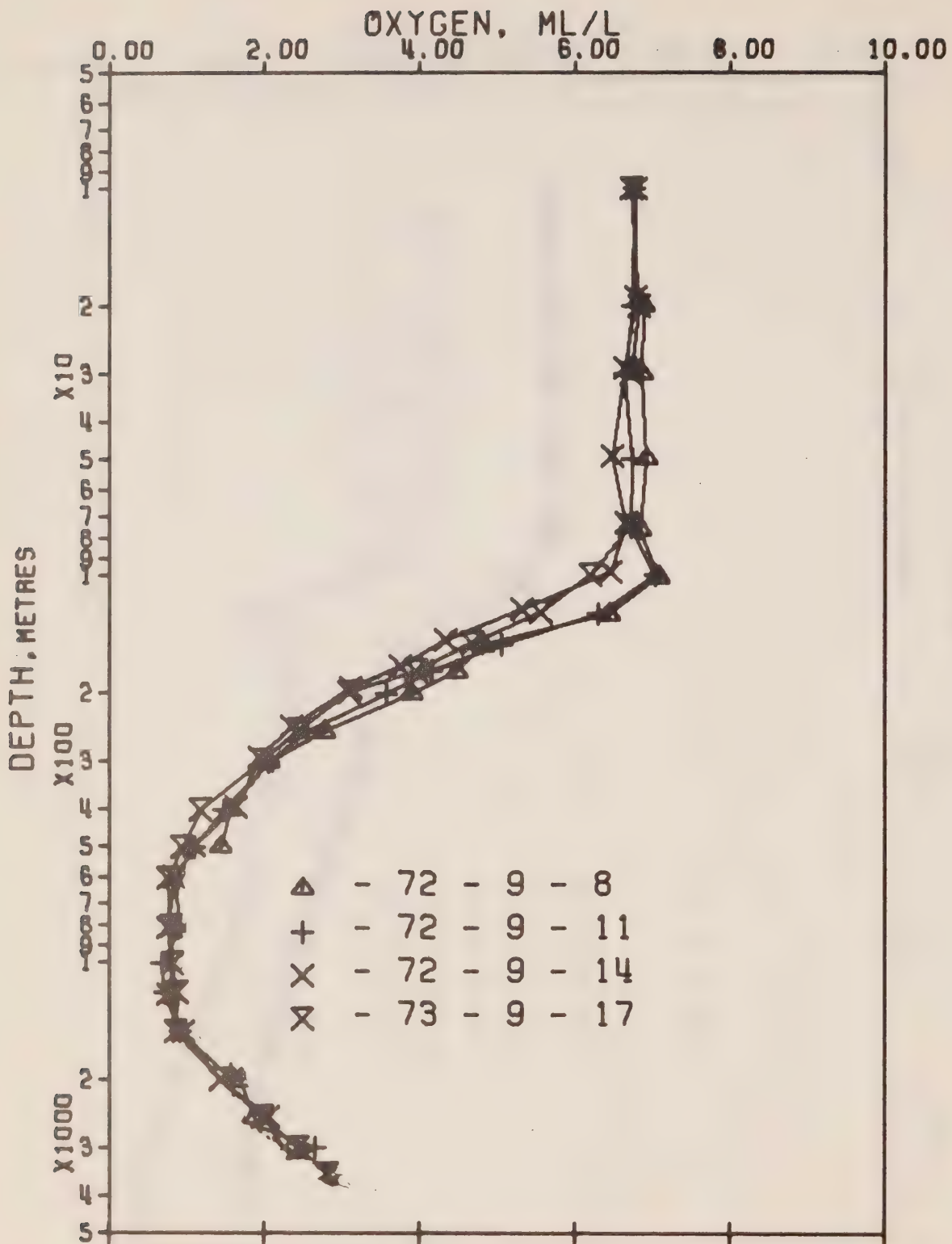
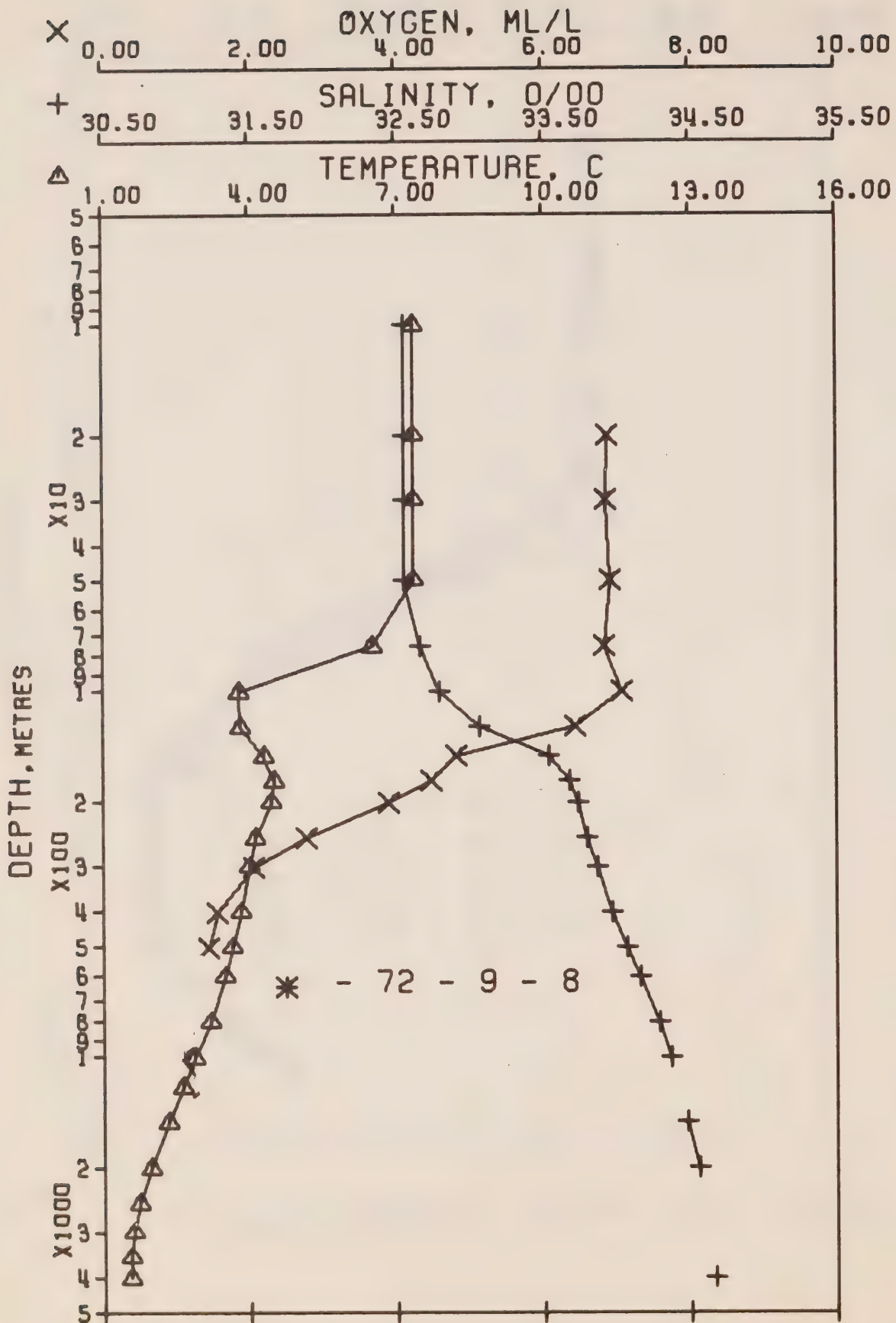


Figure 12

Composite plot of oxygen vs \log_{10} depth. P-72-9. (See note in Programme of Observations P-72-9.)



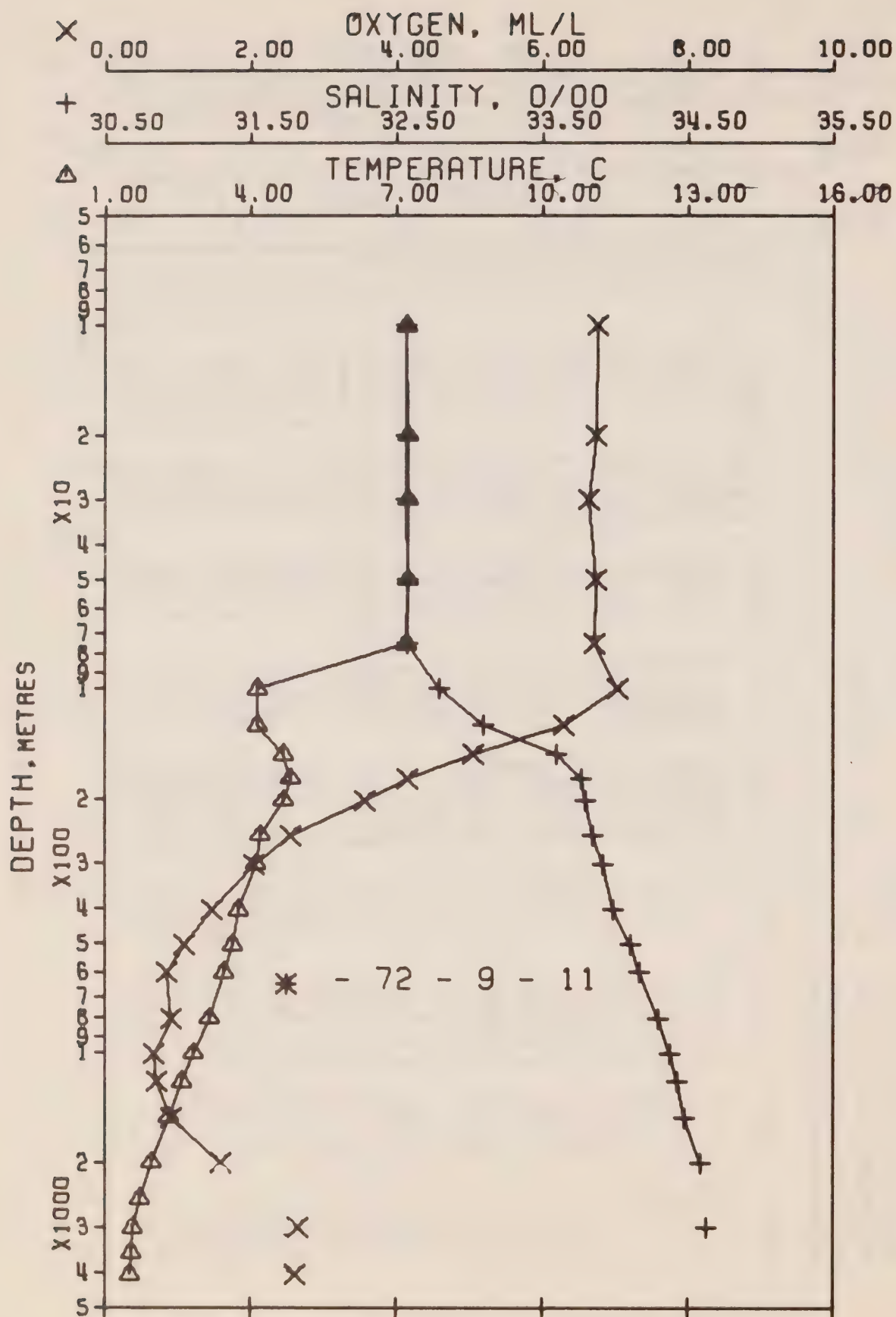
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 9- 8 DATE 5/12/72

POSITION 50- 2.0 N. 145- 2.0 W GMT 18.5

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	7.35	32.564	0	25.479	251.4	7.35	251.2	0.0	0.0	0.0	1477.
10	7.35	32.564	10	25.479	251.5	7.35	251.1	0.25	0.01	0.0	1477.
20	7.35	32.564	20	25.479	251.7	7.35	251.1	0.51	0.05	6.88	1478.
30	7.35	32.565	30	25.480	251.7	7.35	251.0	0.76	0.12	6.86	1478.
50	7.35	32.565	50	25.480	252.0	7.35	251.0	1.27	0.33	6.92	1478.
76	6.53	32.669	76	25.671	234.0	6.52	232.8	1.91	0.74	6.84	1475.
102	3.80	32.805	101	26.087	194.2	3.79	193.3	2.45	1.23	7.08	1465.
127	3.82	33.073	126	26.298	174.4	3.81	173.2	2.91	1.77	6.44	1466.
152	4.30	33.537	151	26.618	144.5	4.29	142.9	3.31	2.34	4.82	1469.
178	4.52	33.679	177	26.707	136.4	4.51	134.4	3.68	2.95	4.48	1470.
203	4.45	33.737	202	26.760	131.5	4.43	129.3	4.01	3.60	3.91	1470.
255	4.11	33.802	253	26.848	123.6	4.09	121.0	4.67	5.13	2.79	1470.
305	3.99	33.871	303	26.915	117.5	3.97	114.6	5.27	6.87	2.07	1470.
407	3.82	33.974	404	27.014	109.0	3.79	105.2	6.43	11.05	1.56	1471.
508	3.64	34.070	504	27.108	100.6	3.60	96.1	7.48	15.98	1.43	1472.
609	3.48	34.164	604	27.198	92.7	3.44	87.6	8.46	21.54	0.0	1473.
811	3.18	34.293	804	27.329	81.4	3.12	75.0	10.21	34.19	0.0	1476.
1018	2.87	34.371	1008	27.420	73.5	2.80	66.3	11.80	49.03	0.0	1478.
1224	2.62	34.425*	1211	27.485	67.9	2.54	60.1	13.25	65.59	0.0	1480.
1530	2.33	34.484	1513	27.556	61.9	2.23	53.2	15.23	93.40	0.0	1484.
2039	1.97	34.564	2014	27.649	54.0	1.83	44.2	18.16	146.69	0.0	1491.
2546	1.73	34.609*	2512	27.704	49.5	1.55	38.8	20.77	207.63	0.0	1499.
3056	1.59	34.635*	3011	27.735	47.3	1.36	35.5	23.22	277.69	0.0	1507.
3571	1.53	34.651*	3515	27.752	46.7	1.25	33.5	25.64	359.33	0.0	1515.
4095	1.53	34.668	4026	27.766	47.0	1.20	31.9	28.09	455.19	0.0	1524.



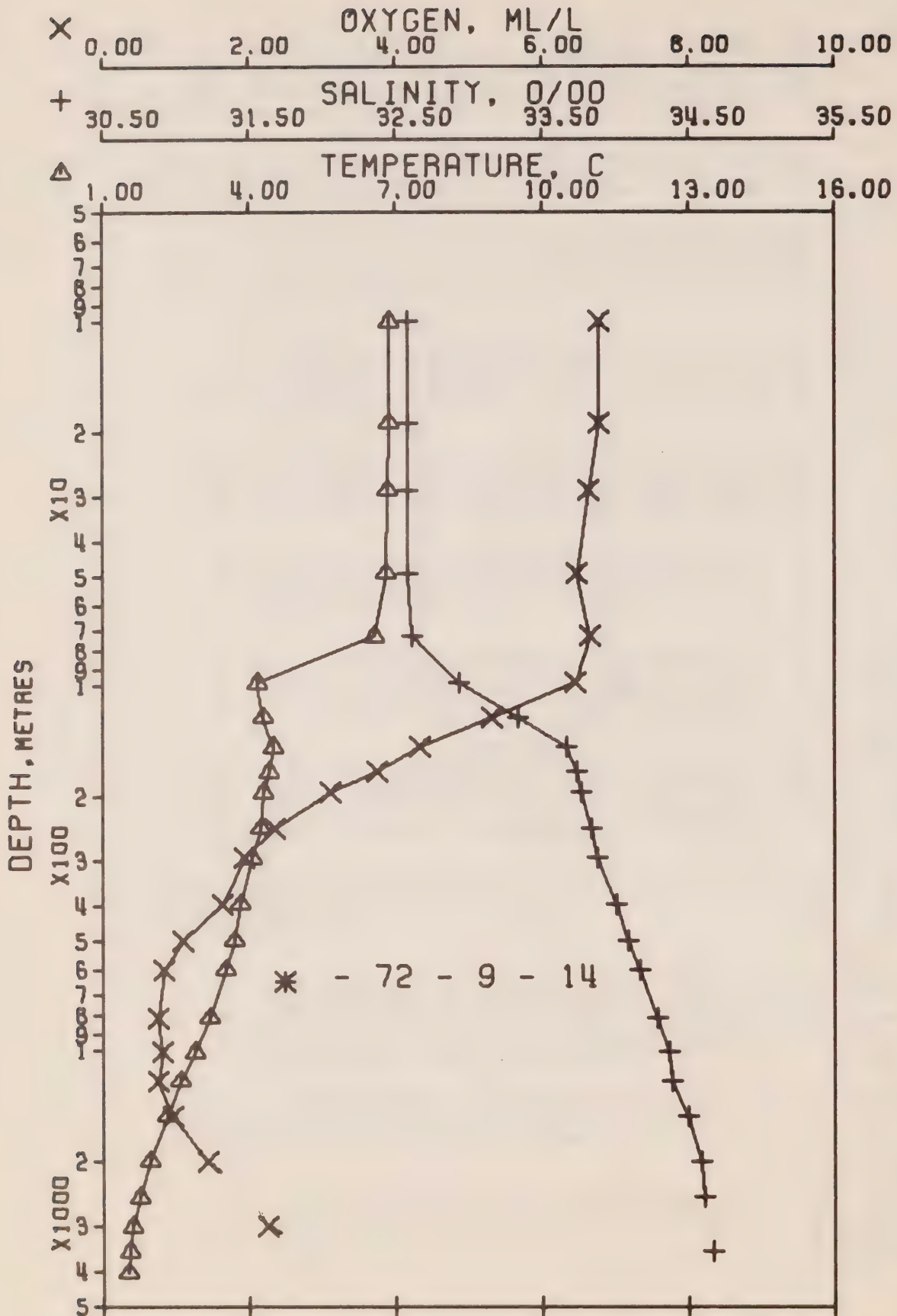
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 9- 11 DATE 11/12/72

POSITION 49-59.0 N. 144-59.0 W GMT 18.3

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	7.23	32.574	0	25.504	249.0	7.23	248.8	0.0	0.0	6.66	1477.
10	7.22	32.572	10	25.503	249.1	7.22	248.8	0.25	0.01	6.76	1477.
20	7.24	32.574	20	25.502	249.5	7.24	248.9	0.50	0.05	6.73	1477.
30	7.24	32.573	30	25.501	249.6	7.24	249.0	0.75	0.12	6.64	1477.
50	7.23	32.578	50	25.507	249.4	7.23	248.4	1.25	0.32	6.75	1478.
75	7.20	32.579	75	25.511	249.3	7.19	248.0	1.89	0.73	6.72	1478.
101	4.16	32.802	100	26.049	197.9	4.15	196.9	2.46	1.24	7.05	1466.
127	4.16	33.097	126	26.283	176.0	4.15	174.7	2.94	1.80	6.29	1467.
152	4.68	33.598	151	26.625	143.9	4.67	142.2	3.34	2.37	5.06	1470.
177	4.83	33.766	176	26.742	133.2	4.82	131.1	3.69	2.95	4.17	1472.
203	4.70	33.802	202	26.785	129.4	4.68	127.0	4.03	3.62	3.57	1471.
254	4.20	33.847	252	26.874	121.1	4.18	118.5	4.66	5.09	2.56	1470.
305	4.11	33.924	303	26.944	114.8	4.09	111.8	5.27	6.81	2.06	1471.
408	3.77	33.986	405	27.028	107.5	3.74	103.7	6.41	10.97	1.48	1471.
509	3.63	34.111	505	27.141	97.5	3.59	93.0	7.44	15.80	1.10	1472.
608	3.45	34.172	603	27.207	91.7	3.41	86.7	8.38	21.12	0.87	1473.
813	3.15	34.305	806	27.342	80.2	3.09	73.8	10.14	33.85	0.92	1476.
1015	2.82	34.381	1005	27.432	72.2	2.75	65.1	11.66	48.03	0.68	1478.
1216	2.58	34.433	1204	27.495	66.8	2.50	59.2	13.06	63.97	0.72	1480.
1521	2.32	34.485	1504	27.558	61.7	2.22	53.0	15.01	91.20	0.92	1484.
2031	1.96	34.588	2006	27.669	52.1	1.82	42.3	18.45	152.00	1.61	1491.
	1.73		2511							0.0	
3065	1.58	34.635	3019	27.736	47.2	1.35	35.4			2.66	1507.
	1.53		3531							0.0	
	1.52		4048							2.63	



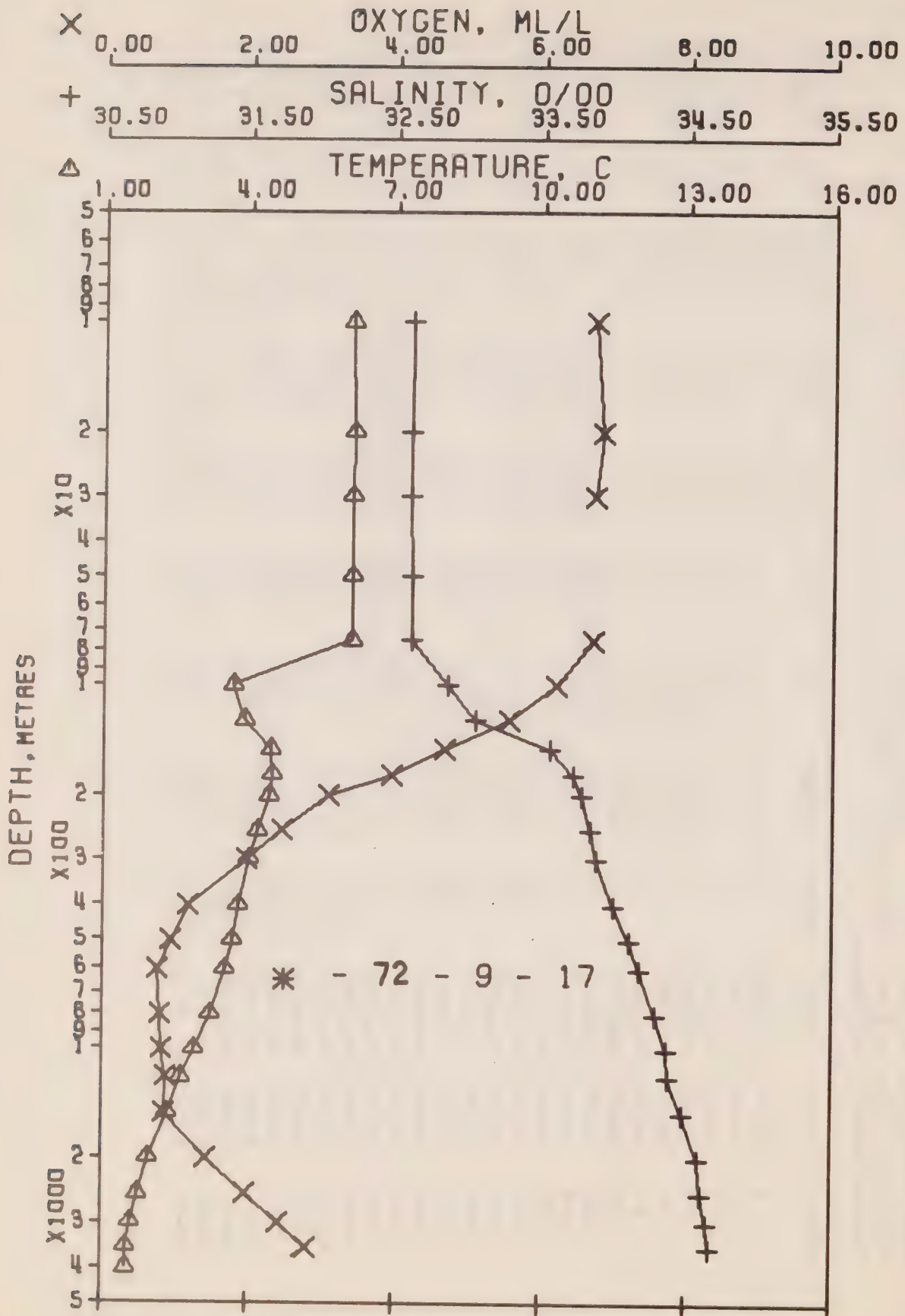
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 9- 14 DATE 18/12/72

POSITION 50- 0.0 N. 145- 0.0 W GMT 17.9

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	6.94	32.592	0	25.557	243.9	6.94	243.7	0.0	0.0	6.61	1476.
10	6.88	32.591	10	25.564	243.4	6.88	243.1	0.25	0.01	6.78	1476.
19	6.89	32.589	19	25.561	243.8	6.89	243.3	0.47	0.05	6.78	1476.
29	6.85	32.592	29	25.569	243.2	6.85	242.5	0.71	0.11	6.65	1476.
49	6.83	32.591	49	25.571	243.3	6.83	242.4	1.20	0.30	6.49	1476.
73	6.59	32.620	73	25.625	238.4	6.58	237.2	1.79	0.67	6.65	1475.
99	4.17	32.939	98	26.157	187.7	4.16	186.7	2.33	1.14	6.46	1466.
123	4.29	33.344	122	26.466	158.6	4.28	157.3	2.74	1.61	5.33	1468.
148	4.51	33.675	147	26.705	136.4	4.50	134.6	3.11	2.12	4.34	1470.
173	4.42	33.736	172	26.763	131.0	4.41	129.1	3.45	2.67	3.77	1470.
197	4.31	33.775	196	26.805	127.2	4.30	125.1	3.76	3.26	3.12	1470.
248	4.23	33.839	246	26.864	122.0	4.21	119.4	4.38	4.68	2.35	1470.
298	4.06	33.884	296	26.918	117.2	4.04	114.3	4.99	6.36	1.95	1470.
400	3.83	34.007	397	27.039	106.5	3.80	102.7	6.13	10.41	1.64	1471.
502	3.69	34.095	498	27.123	99.2	3.65	94.8	7.17	15.22	1.11	1473.
604	3.51	34.174	599	27.203	92.2	3.47	87.1	8.15	20.72	0.83	1474.
819	3.18	34.294	811	27.330	81.3	3.12	74.9	10.00	34.13	0.75	1476.
1018	2.89	34.369	1003	27.416	73.8	2.82	66.7	11.54	48.53	0.82	1478.
1217	2.59	34.388	1205	27.458	70.3	2.51	62.7	12.97	64.92	0.76	1480.
1521	2.33	34.499	1504	27.568	60.8	2.23	52.1	14.96	92.63	0.96	1484.
2030	1.97	34.588	2005	27.669	52.2	1.83	42.3	17.79	143.77	1.44	1491.
2544	1.75	34.607	2510	27.701	49.9	1.57	39.0	20.40	204.70	0.0	1499.
3062	1.59	34.637*	3017	27.737	47.2	1.36	35.3	22.91	276.38	2.26	1507.
3581	1.53	34.673	3524	27.770	45.3	1.25	31.9	25.30	357.36	0.0	1516.
4098	1.52	34.709*	4029	27.799	43.9	1.19	28.8	27.61	447.64	0.0	1524.



OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 9- 17 DATE 2/ 1/73

POSITION 49-58.0 N. 144-56.0 W GMT 20.9

HYDROGRAPHIC CAST DATA

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	THETA	SVA (THETA)	DELTA D	POT. EN	OXY	SOUND
0	6.08	32.605	0	25.677	232.5	6.08	232.3	0.0	0.0	6.95	1472.
10	6.09	32.608	10	25.679	232.5	6.09	232.1	0.23	0.01	6.72	1472.
20	6.12	32.601	20	25.669	233.5	6.12	233.0	0.47	0.05	6.82	1473.
30	6.10	32.602	30	25.673	233.3	6.10	232.7	0.70	0.11	6.73	1473.
50	6.09	32.611	50	25.681	232.7	6.09	231.9	1.17	0.30	0.0	1473.
75	6.09	32.613	75	25.683	232.8	6.08	231.7	1.76	0.68	6.71	1474.
101	3.66	32.857	100	26.142	189.0	3.65	188.1	2.30	1.16	6.21	1464.
126	3.92	33.050	125	26.270	177.1	3.91	175.9	2.76	1.69	5.55	1466.
151	4.44	33.565	150	26.625	143.8	4.43	142.2	3.16	2.26	4.67	1469.
177	4.47	33.718	176	26.743	132.9	4.46	131.0	3.52	2.86	3.96	1470.
202	4.41	33.782	201	26.800	127.7	4.40	125.5	3.85	3.49	3.11	1470.
253	4.17	33.837	251	26.869	121.5	4.15	118.9	4.47	4.94	2.45	1470.
303	4.01	33.884	301	26.923	116.8	3.99	113.8	5.07	6.65	1.98	1470.
406	3.80	34.000	403	27.036	106.8	3.77	103.0	6.22	10.81	1.19	1471.
508	3.67	34.113	504	27.139	97.7	3.63	93.2	7.26	15.65	0.94	1473.
611	3.53	34.183	606	27.208	91.8	3.49	86.6	8.24	21.21	0.76	1474.
813	3.22	34.287	806	27.321	82.3	3.16	75.8	9.99	33.96	0.80	1476.
1015	2.89	34.375	1005	27.421	73.4	2.82	66.2	11.55	48.46	0.81	1478.
1216	2.62	34.383	1204	27.451	71.0	2.54	63.3	13.00	65.00	0.89	1480.
1521	2.34	34.485	1504	27.556	61.9	2.24	53.2	15.03	93.25	0.87	1484.
2029	1.97	34.587	2004	27.668	52.3	1.83	42.4	17.89	144.92	1.44	1491.
2540	1.74	34.614	2506	27.707	49.3	1.56	38.4	20.47	205.10	1.99	1499.
3053	1.59	34.655	3009	27.751	45.8	1.36	34.0	22.90	274.27	2.43	1507.
3566	1.52	34.668	3510	27.767	45.4	1.24	32.2	25.23	352.93	2.82	1515.
4090	1.51	34.681*	4011	27.778	45.7	1.18	30.8	27.56	443.97	0.0	1524.

RESULTS OF STD CASTS

(P-72-9)

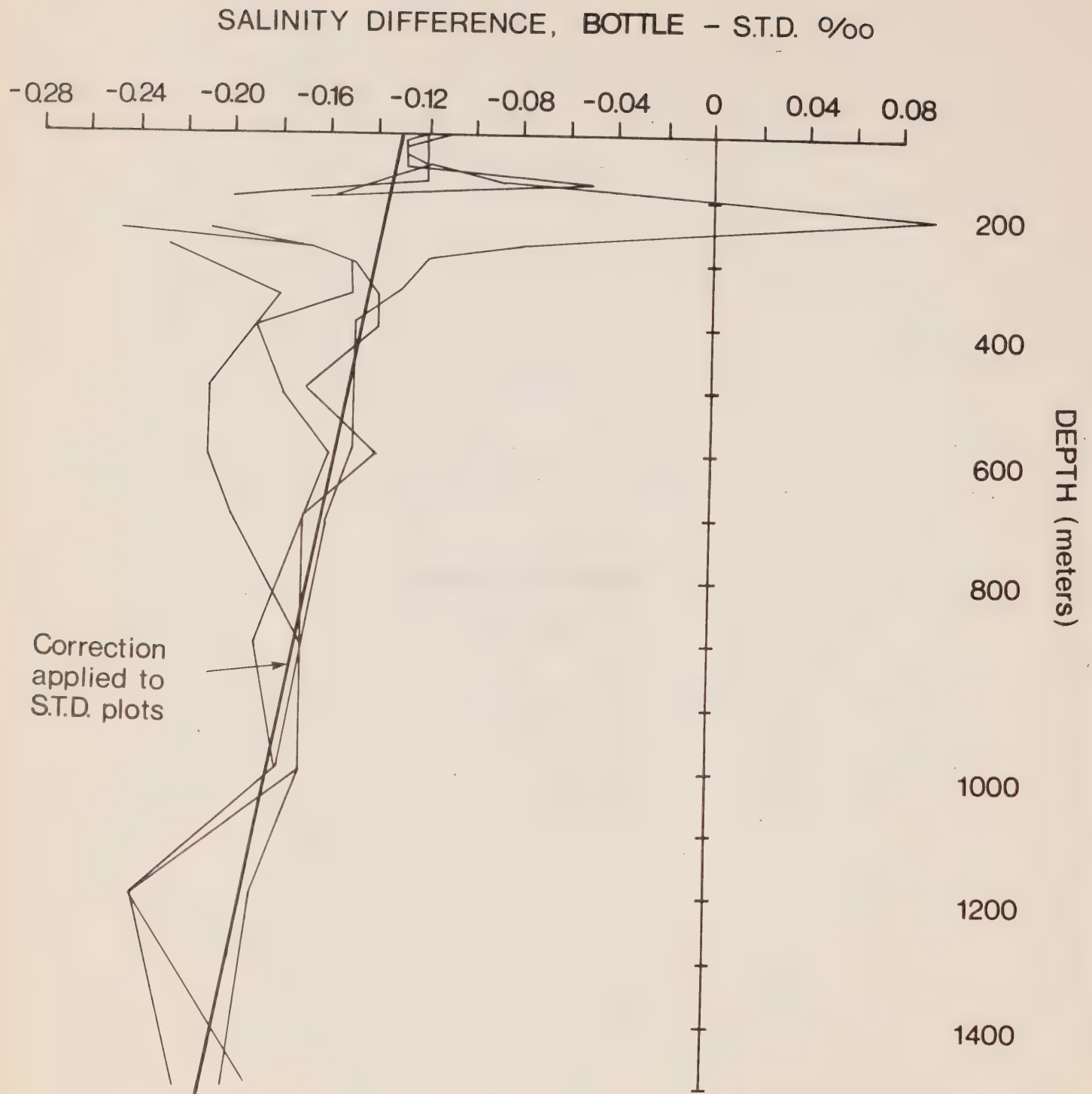


Figure 13

Bottle - STD salinity value difference profiles. P-72-9.

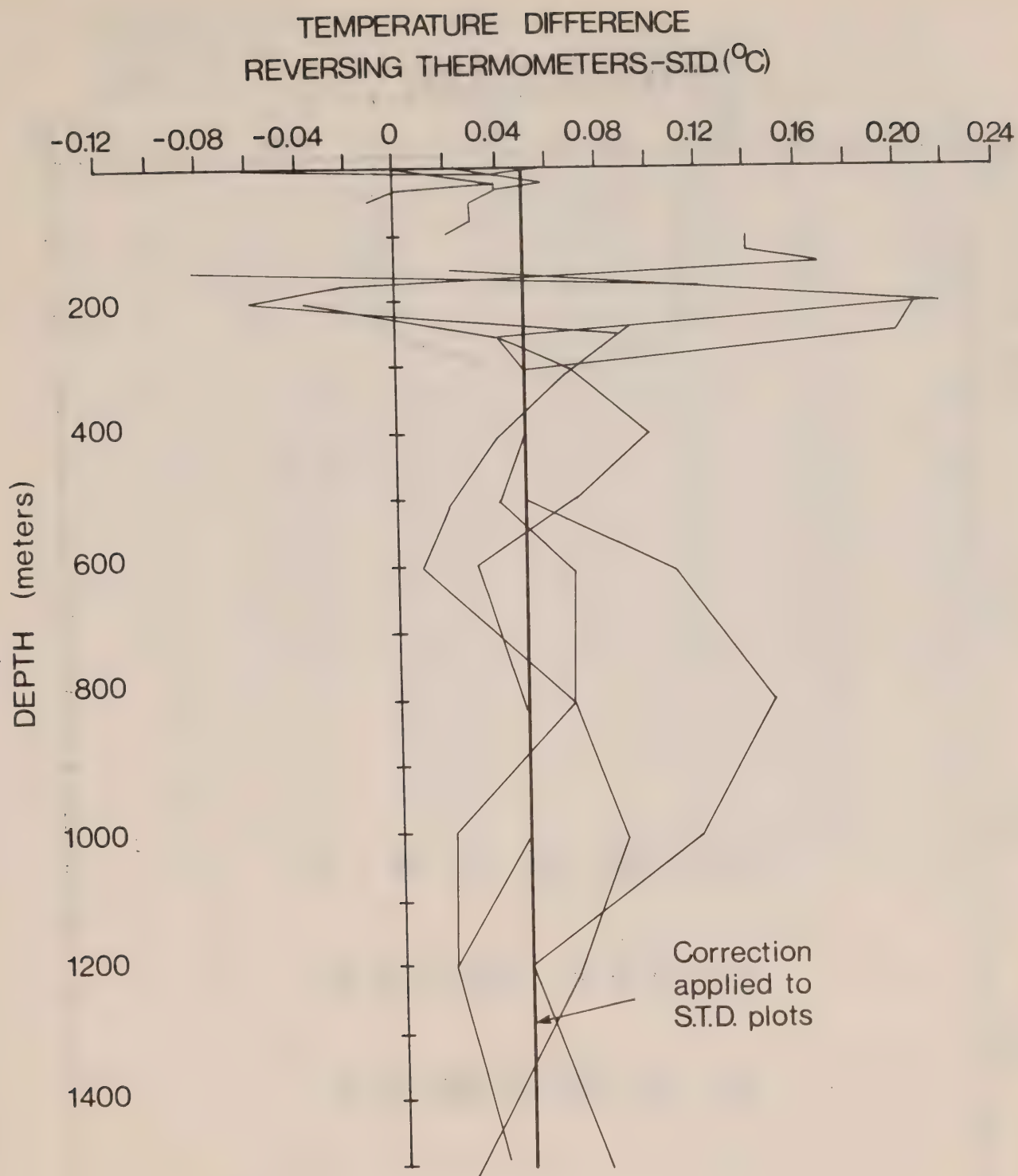
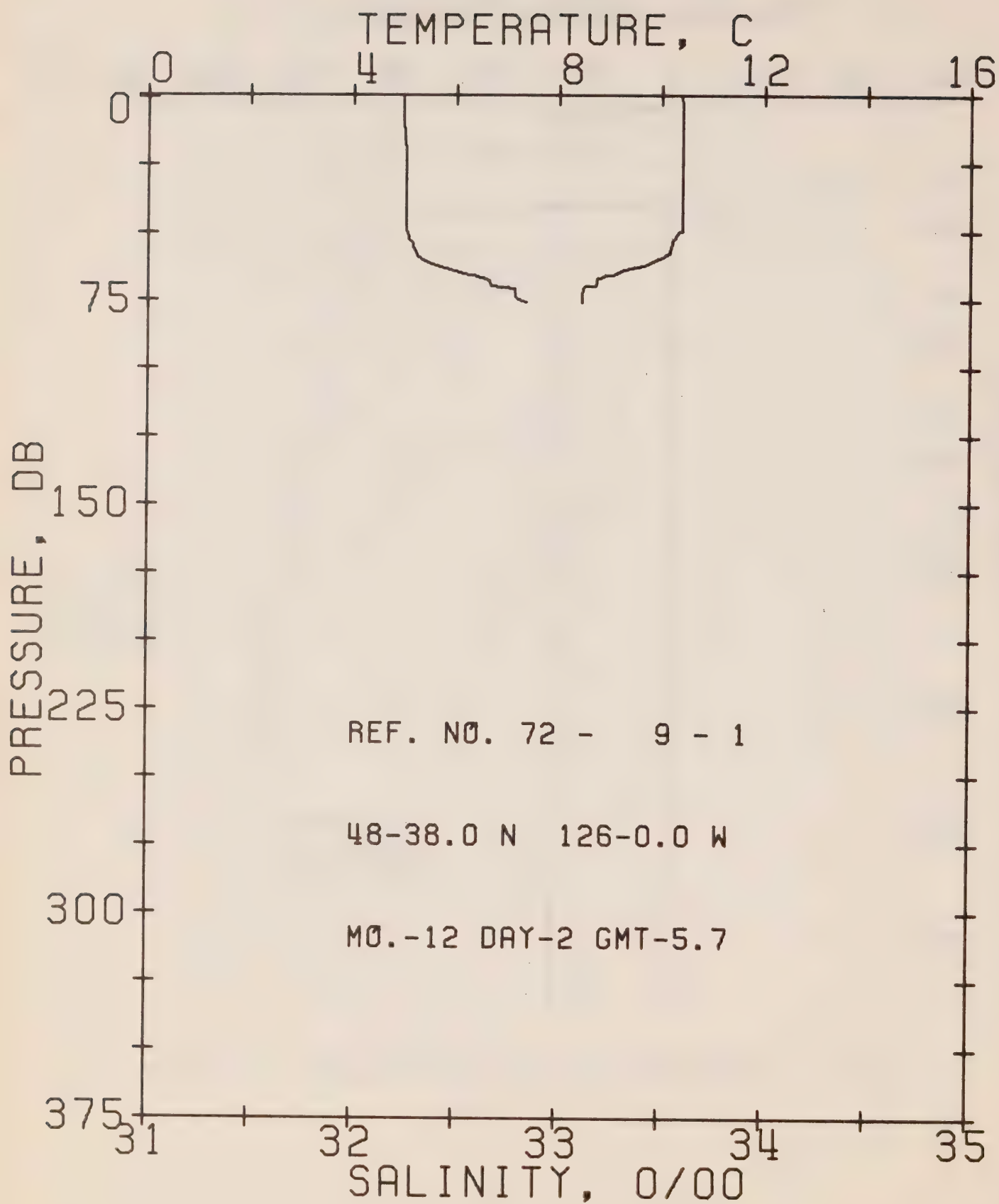


Figure 14

Temperature difference reversing thermometers - STD. P-72-9.



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REFERENCE NO. 72- 9- 1

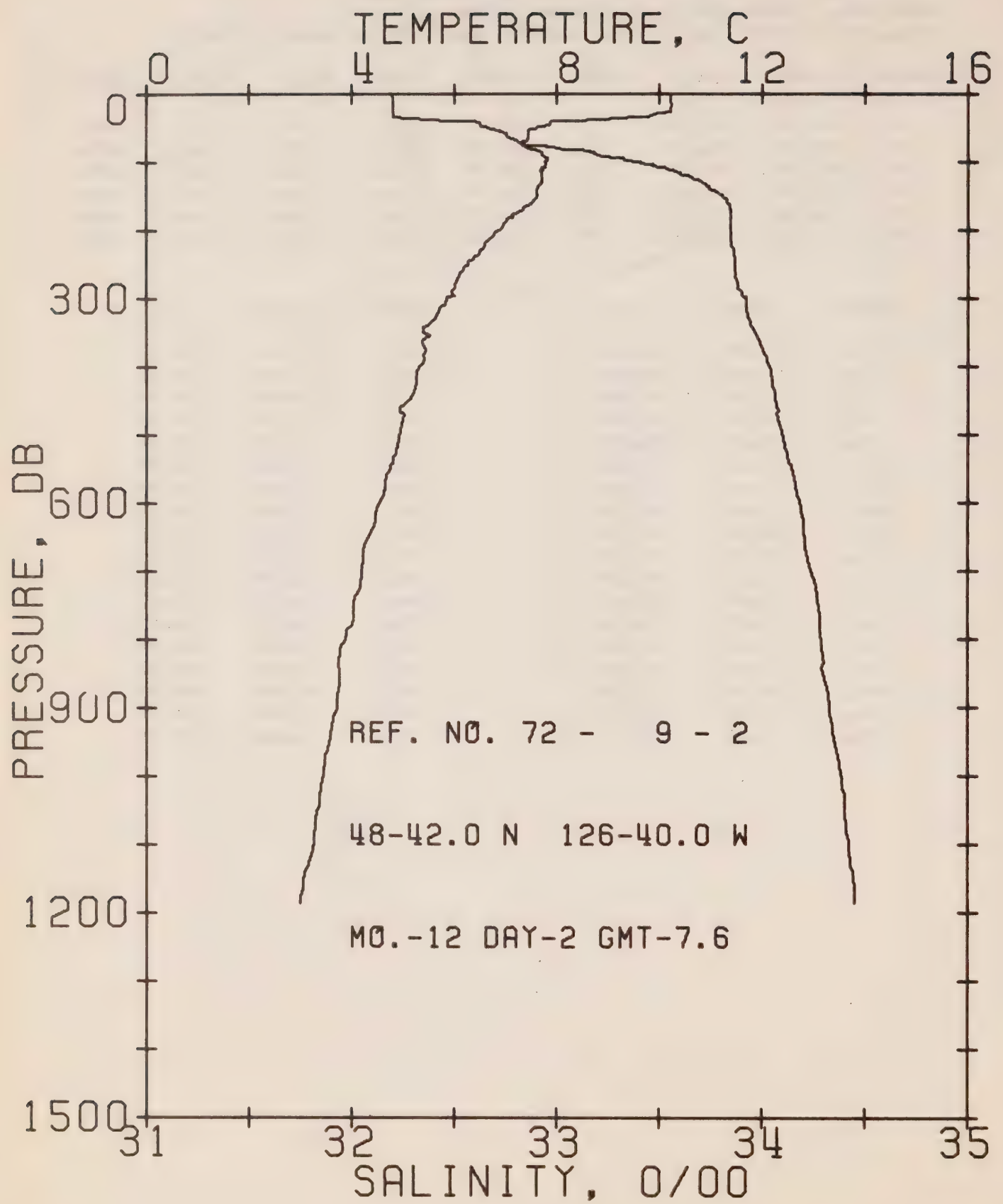
DATE 2/12/72

POSITION 48-38.0N, 126- 0.0W GMT 5.7

RESULTS OF STP CAST 36 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	PCT. EN	SCUND
0	10.38	32.24	0	24.76	319.6	0.0	0.0	1488.
10	10.40	32.24	10	24.76	320.3	0.32	0.02	1488.
20	10.40	32.25	20	24.76	319.8	0.64	0.07	1489.
30	10.40	32.25	30	24.76	319.9	0.96	0.15	1489.
50	10.40	32.25	50	24.76	320.3	1.60	0.41	1489.
75	8.46	32.30	75	25.50	250.2	2.32	0.86	1483.

DEPTH	TEMP	SAL	DEPTH	TEMP	SAL
0.	10.38	32.24	59.	10.04	32.31
5.	10.39	32.24	60.	9.96	32.33
5.	10.39	32.24	61.	9.80	32.35
5.	10.40	32.24	62.	9.74	32.38
9.	10.40	32.24	63.	9.52	32.42
22.	10.40	32.25	64.	9.28	32.47
37.	10.40	32.25	66.	9.05	32.56
49.	10.40	32.25	66.	8.90	32.58
50.	10.40	32.25	67.	8.83	32.62
50.	10.35	32.25	67.	8.78	32.63
51.	10.32	32.26	68.	8.76	32.66
53.	10.25	32.27	69.	8.75	32.66
54.	10.22	32.28	70.	8.72	32.67
55.	10.20	32.29	70.	8.54	32.67
56.	10.19	32.29	71.	8.47	32.79
56.	10.19	32.29	74.	8.46	32.79
58.	10.16	32.30	75.	8.46	32.80
59.	10.12	32.30	76.	8.46	32.84



OFFSHORE OCEANOGRAPHY GROUP

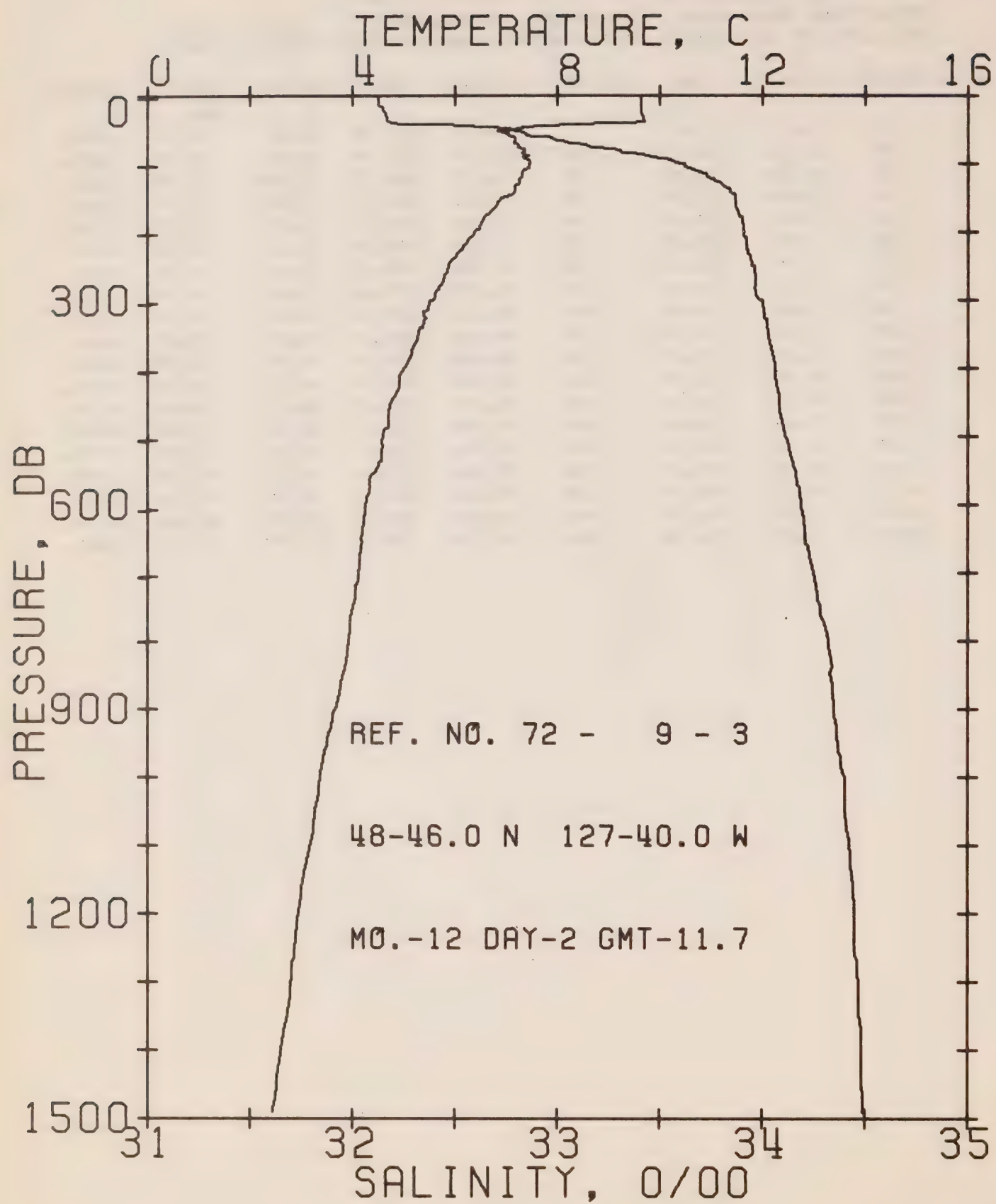
REFERENCE NO. 72- 9- 2

DATE 2/12/72

POSITION 48-42.0N, 126-40.0W GMT 7.6

RESULTS OF STP CAST 278 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	10.22	32.18	0	24.74	321.4	0.0	0.0	1488.
10	10.22	32.20	10	24.76	320.4	0.32	0.02	1488.
20	10.22	32.20	20	24.76	320.5	0.64	0.07	1488.
30	9.92	32.20	30	24.81	316.0	0.96	0.15	1487.
50	7.61	32.67	50	25.53	247.6	1.52	0.37	1479.
75	7.34	32.85	75	25.71	230.9	2.11	0.75	1479.
100	7.77	33.37	99	26.05	198.5	2.65	1.22	1482.
125	7.72	33.67	124	26.29	175.8	3.11	1.75	1482.
150	7.60	33.81	149	26.42	164.4	3.53	2.35	1482.
175	7.20	33.85	174	26.51	156.1	3.93	3.01	1481.
200	6.89	33.85	199	26.55	152.4	4.32	3.75	1480.
225	6.55	33.85	223	26.60	148.0	4.69	4.56	1479.
250	6.27	33.87	248	26.65	143.5	5.06	5.44	1479.
300	5.84	33.92	298	26.74	135.0	5.76	7.40	1478.
400	5.32	34.03	397	26.89	121.5	7.04	11.97	1478.
500	4.91	34.10	496	26.99	112.9	8.21	17.32	1478.
600	4.52	34.18	595	27.10	102.5	9.29	23.38	1478.
800	3.87	34.29	793	27.26	89.4	11.21	37.01	1478.
1000	3.42	34.38	991	27.38	78.6	12.90	52.48	1480.



OFFSHORE OCEANOGRAPHY GROUP

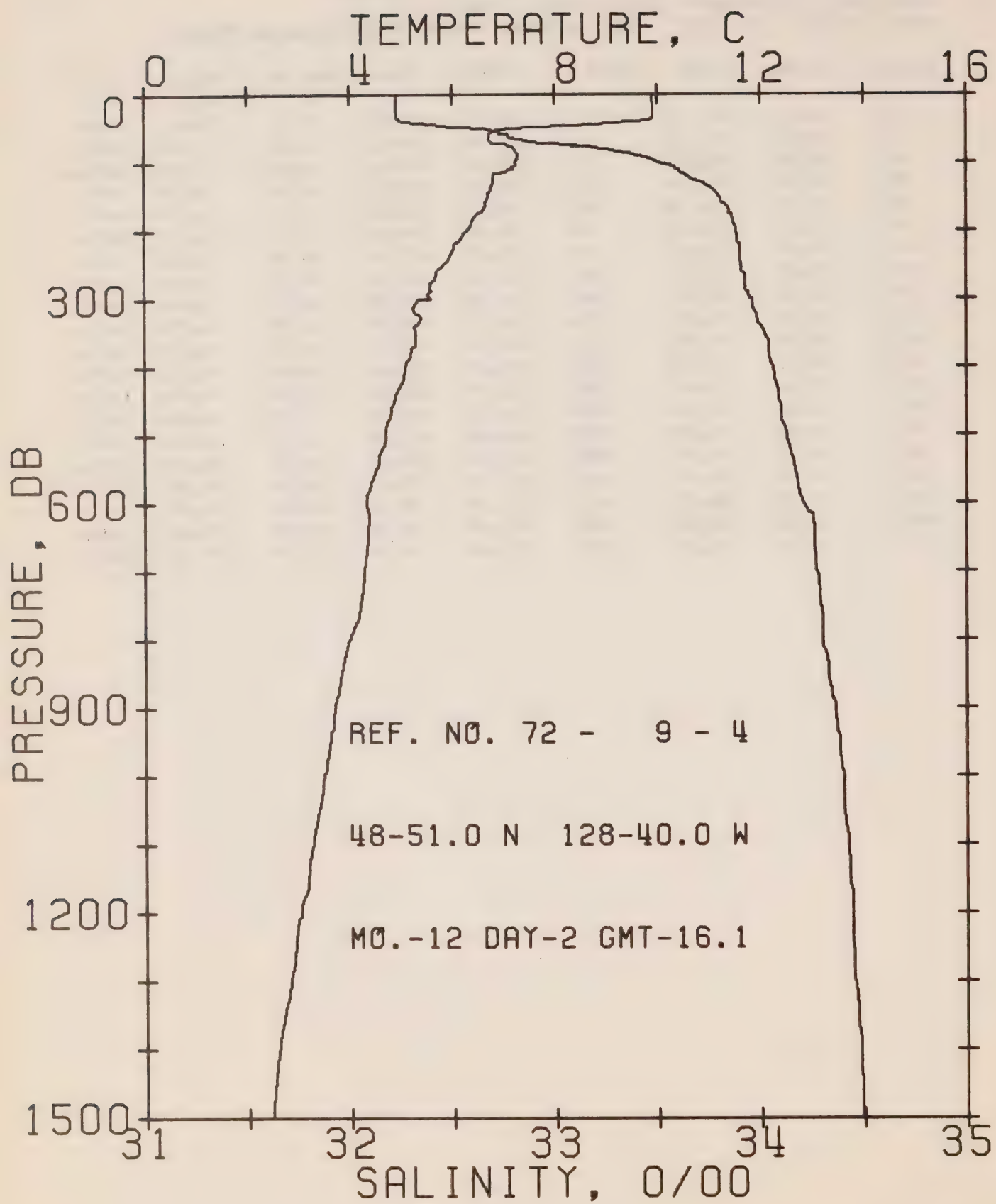
REFERENCE NO. 72- 9- 3

DATE 2/12/72

POSITION 48-46.0N, 127-40.0W GMT 11.7

RESULTS OF STP CAST 244 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	9.63	32.12	0	24.79	316.6	0.0	0.0	1485.
10	9.62	32.13	10	24.80	316.2	0.32	0.02	1485.
20	9.64	32.15	20	24.81	315.2	0.63	0.06	1486.
30	9.66	32.16	30	24.82	315.0	0.95	0.14	1486.
50	7.17	32.78	50	25.67	233.6	1.52	0.38	1478.
75	7.23	33.15	75	25.96	206.8	2.07	0.72	1479.
100	7.47	33.61	99	26.28	176.4	2.55	1.15	1481.
125	7.25	33.77	124	26.44	162.0	2.97	1.63	1480.
150	6.93	33.87	149	26.56	150.6	3.36	2.18	1480.
175	6.62	33.88	174	26.62	145.8	3.73	2.79	1479.
200	6.38	33.91	199	26.67	141.2	4.09	3.48	1478.
225	6.12	33.92	223	26.71	137.5	4.44	4.23	1478.
250	5.86	33.95	248	26.77	132.3	4.77	5.04	1477.
300	5.54	33.98	298	26.83	126.4	5.42	6.86	1477.
400	4.99	34.06	397	26.96	115.4	6.63	11.15	1476.
500	4.60	34.11	496	27.04	108.1	7.75	16.28	1476.
600	4.25	34.19	595	27.14	99.1	8.78	22.08	1477.
800	3.93	34.32	793	27.28	87.7	10.66	35.45	1479.
1000	3.35	34.40	991	27.40	76.8	12.32	50.61	1480.
1200	2.92	34.45	1188	27.48	69.4	13.79	67.05	1481.



OFFSHORE OCEANOGRAPHY GROUP

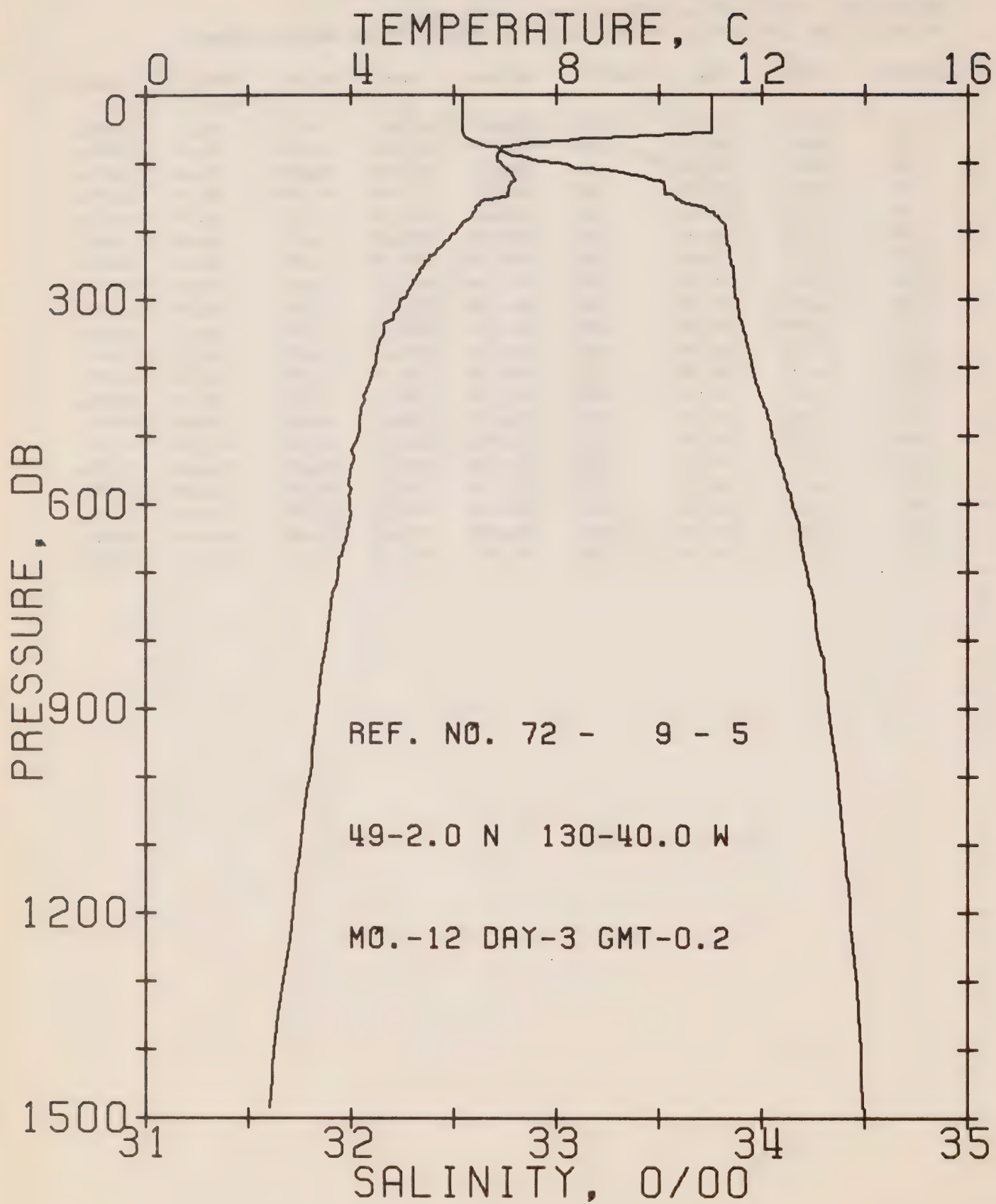
REFERENCE NO. 72- 9- 4

DATE 2/12/72

POSITION 48-51.0N, 128-40.0W GMT 16.1

RESULTS OF STP CAST 226 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	9.89	32.23	0	24.83	312.5	0.0	0.0	1486.
10	9.90	32.23	10	24.83	313.1	0.31	0.02	1487.
20	9.91	32.23	20	24.83	313.4	0.63	0.06	1487.
30	9.91	32.23	30	24.83	313.6	0.94	0.14	1487.
50	7.23	32.60	50	25.52	247.8	1.53	0.38	1478.
75	7.09	33.09	75	25.93	209.7	2.10	0.74	1478.
100	7.23	33.51	99	26.24	180.6	2.58	1.17	1480.
125	6.80	33.69	124	26.44	161.9	3.01	1.66	1479.
150	6.69	33.79	149	26.54	153.1	3.40	2.21	1479.
175	6.49	33.85	174	26.61	146.7	3.78	2.83	1478.
200	6.29	33.88	199	26.66	142.3	4.14	3.52	1478.
225	6.01	33.90	223	26.71	137.6	4.49	4.28	1477.
250	5.82	33.91	248	26.74	134.8	4.83	5.11	1477.
300	5.58	33.95	298	26.80	129.5	5.49	6.95	1477.
400	5.08	34.06	397	26.94	116.7	6.70	11.28	1477.
500	4.69	34.13	496	27.05	107.7	7.83	16.42	1477.
600	4.32	34.21	595	27.15	98.7	8.86	22.20	1477.
800	3.97	34.30	793	27.26	89.5	10.74	35.57	1479.
1000	3.47	34.40	991	27.39	77.9	12.40	50.81	1480.
1200	3.00	34.44	1188	27.46	71.0	13.89	67.53	1482.



OFFSHORE OCEANOGRAPHY GROUP

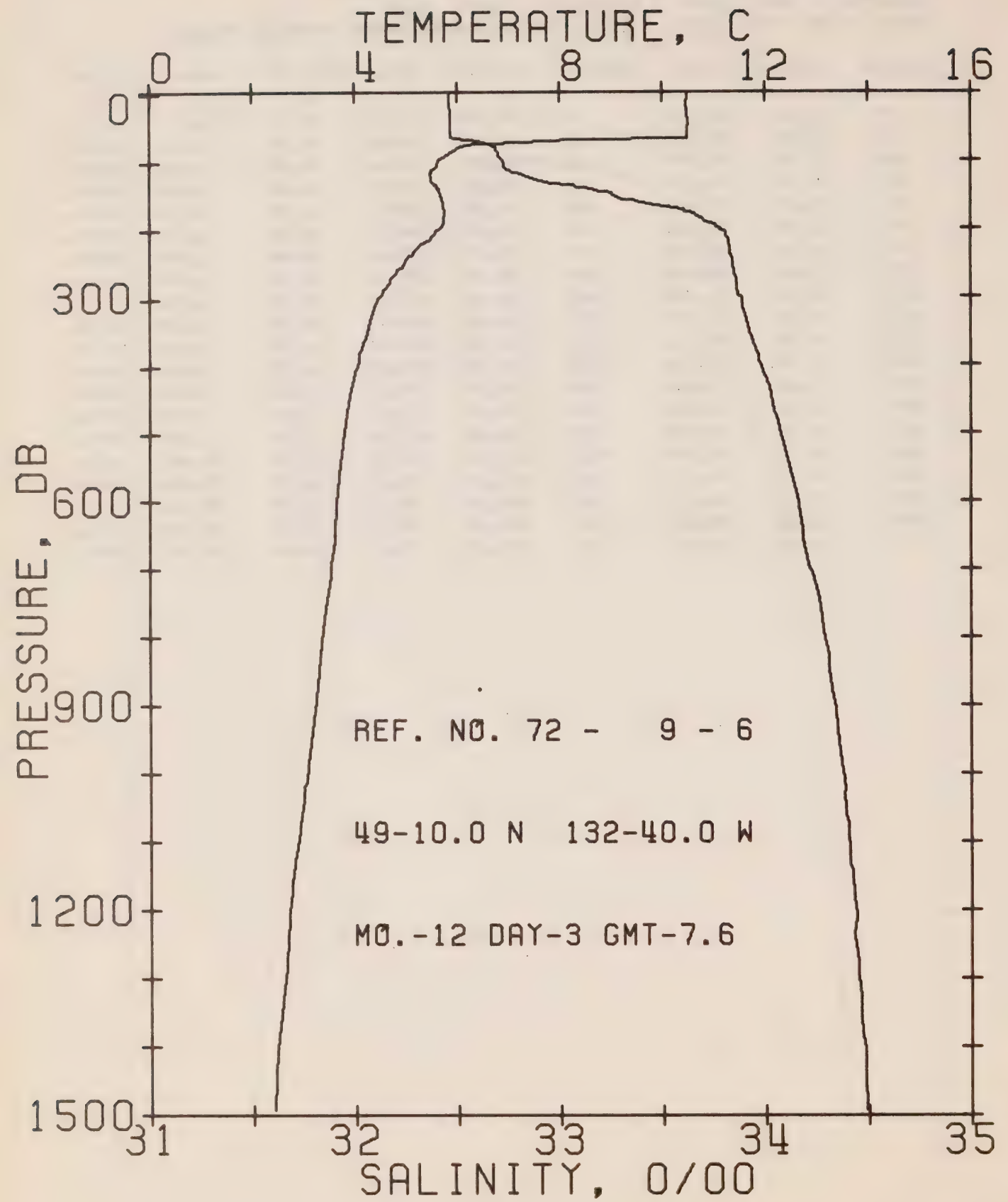
REFERENCE NO. 72- 9- 5

DATE 3/12/72

POSITION 49- 2.0N, 130-40.0W GMT 0.2

RESULTS OF STP CAST 213 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	11.00	32.53	0	24.88	308.3	0.0	0.0	1491.
10	11.00	32.54	10	24.89	308.0	0.31	0.02	1491.
20	11.01	32.54	20	24.88	308.4	0.62	0.06	1491.
30	11.02	32.54	30	24.88	308.7	0.92	0.14	1491.
50	11.02	32.54	50	24.88	309.1	1.54	0.39	1492.
75	7.13	32.65	75	25.58	242.7	2.24	0.83	1478.
100	6.91	32.99	99	25.87	215.2	2.82	1.35	1478.
125	7.21	33.49	124	26.23	182.3	3.31	1.91	1480.
150	7.02	33.58	149	26.32	173.4	3.76	2.54	1480.
175	6.35	33.77	174	26.56	150.9	4.16	3.20	1478.
200	6.05	33.83	199	26.65	143.0	4.52	3.90	1477.
225	5.72	33.34	223	26.70	138.5	4.88	4.66	1476.
250	5.42	33.85	248	26.74	134.5	5.22	5.49	1475.
300	5.00	33.87	298	26.81	128.3	5.87	7.33	1474.
400	4.45	33.95	397	26.93	117.2	7.10	11.67	1474.
500	4.12	34.05	496	27.04	107.3	8.21	16.80	1474.
600	3.97	34.15	595	27.14	99.2	9.24	22.56	1475.
800	3.50	34.27	793	27.28	86.3	11.09	35.68	1477.
1000	3.18	34.37	991	27.39	77.0	12.72	50.58	1479.
1200	2.85	34.43	1188	27.47	70.0	14.19	67.03	1481.



OFFSHORE OCEANOGRAPHY GROUP

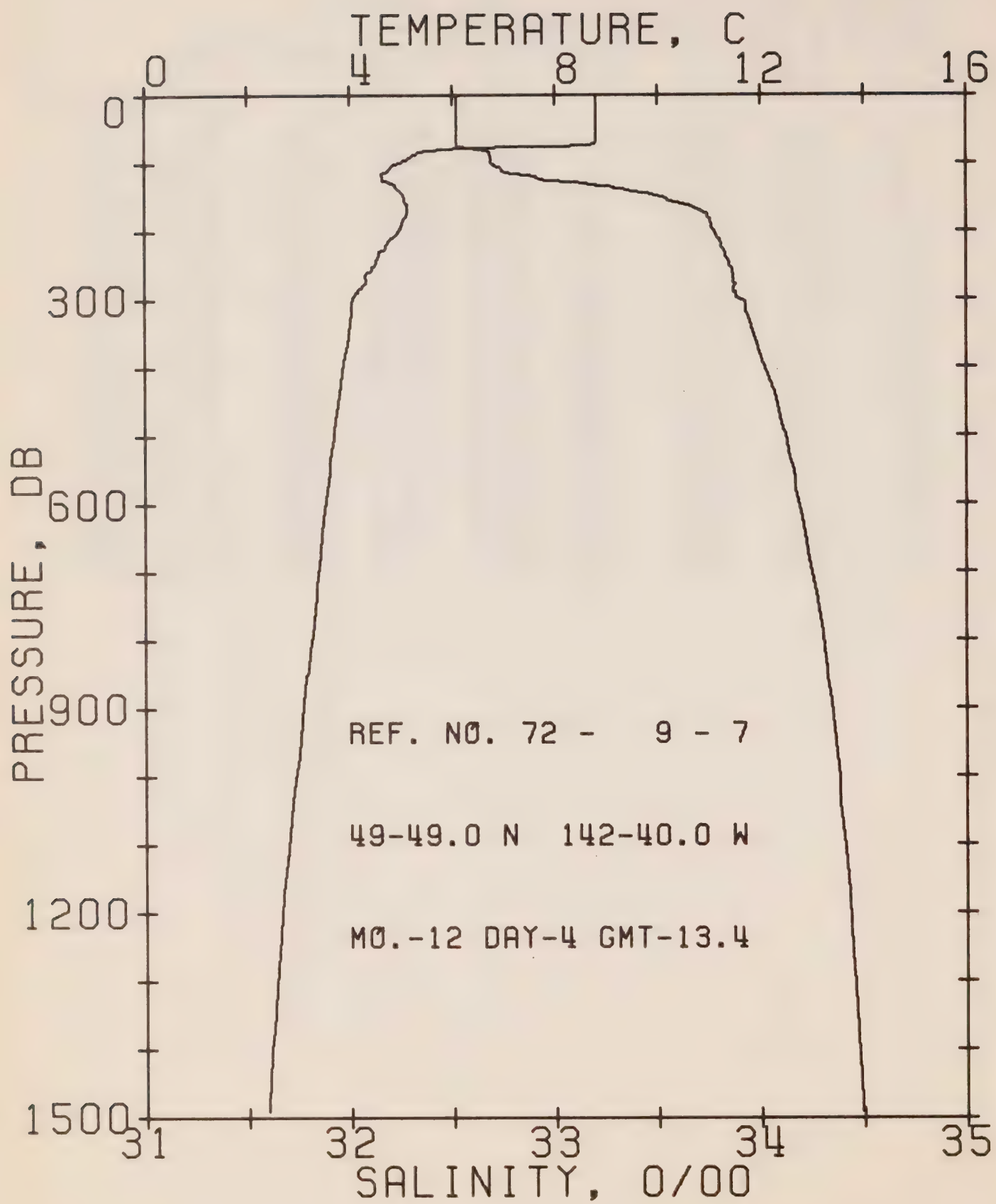
REFERENCE NO. 72- 9- 6

DATE 3/12/72

POSITION 49-10.0N. 132-40.0W GMT 7.6

RESULTS OF STP CAST 160 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	10.48	32.45	0	24.91	305.6	0.0	0.0	1489.
10	10.47	32.46	10	24.92	305.1	0.31	0.02	1489.
20	10.46	32.46	20	24.92	305.2	0.61	0.06	1489.
30	10.49	32.47	30	24.92	305.1	0.92	0.14	1489.
50	10.49	32.47	50	24.92	305.6	1.53	0.39	1490.
75	6.93	32.64	75	25.60	241.2	2.26	0.86	1477.
100	5.66	32.72	99	25.82	220.3	2.83	1.36	1472.
125	5.48	32.86	124	25.95	207.8	3.37	1.98	1472.
150	5.69	33.25	149	26.23	181.3	3.86	2.66	1474.
175	5.76	33.61	174	26.51	155.5	4.28	3.36	1475.
200	5.65	33.78	199	26.66	141.9	4.65	4.07	1475.
225	5.28	33.82	223	26.74	134.5	5.00	4.82	1474.
250	4.96	33.84	248	26.79	129.9	5.33	5.62	1473.
300	4.49	33.87	298	26.87	122.5	5.96	7.38	1472.
400	4.04	33.98	397	26.99	110.9	7.12	11.53	1472.
500	3.79	34.07	496	27.09	102.0	8.18	16.39	1473.
600	3.63	34.16	595	27.18	94.7	9.17	21.89	1474.
800	3.34	34.29	793	27.31	83.4	10.95	34.60	1476.
1000	3.05	34.38	990	27.41	75.0	12.54	49.09	1478.
1200	2.70	34.44	1168	27.49	67.8	13.97	65.09	1480.



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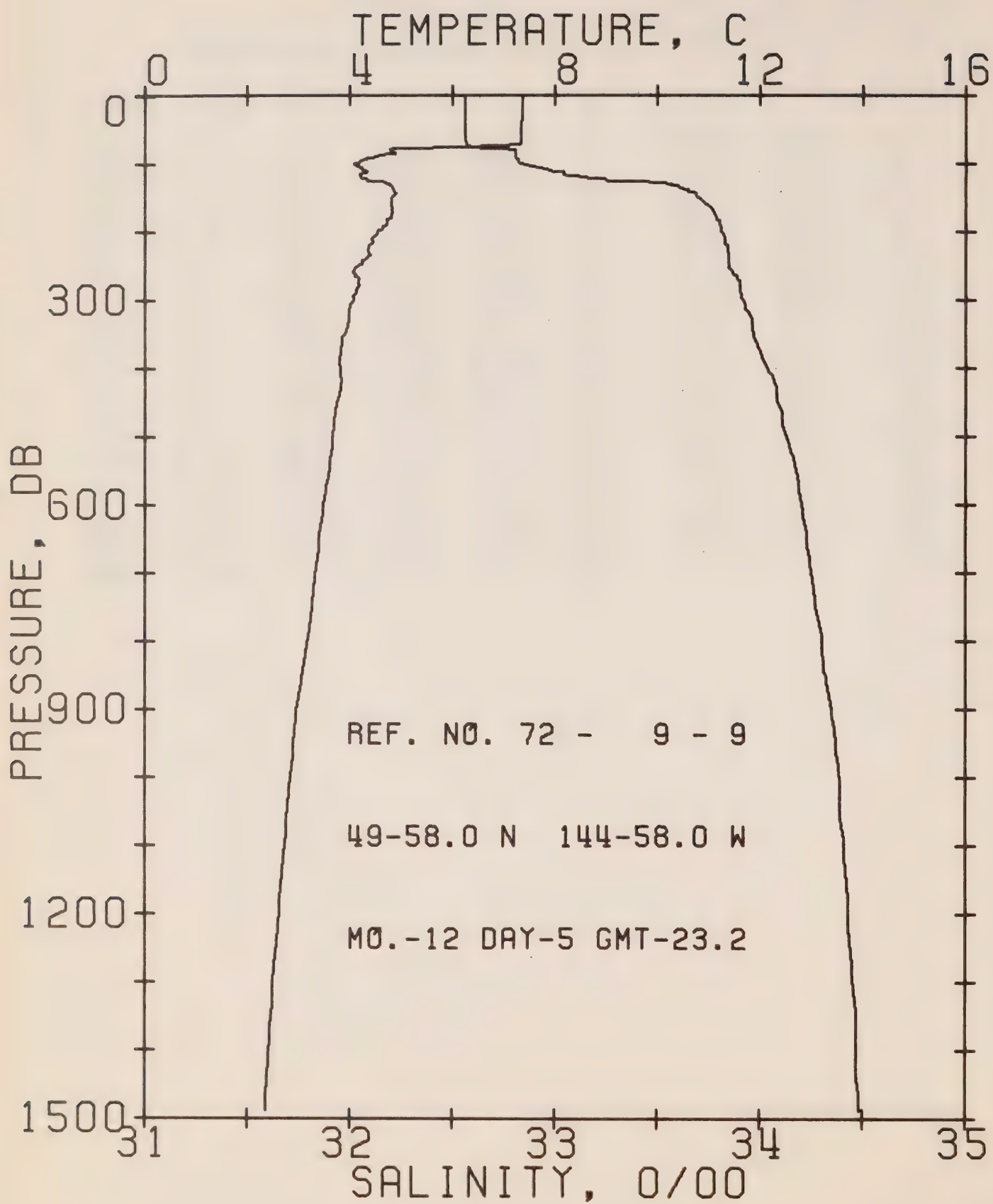
REFERENCE NO. 72- 9- 7

DATE 4/12/72

POSITION 49-49.0N, 142-40.0W GMT 13.4

RESULTS OF STD CAST 164 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	8.80	32.51	0	25.23	275.2	0.0	0.0	1483.
10	8.80	32.52	10	25.23	274.5	0.27	0.01	1483.
20	8.81	32.52	20	25.23	275.2	0.55	0.06	1483.
30	8.81	32.52	30	25.23	275.4	0.83	0.13	1483.
50	8.81	32.52	50	25.23	275.7	1.38	0.35	1484.
75	7.94	32.52	75	25.36	263.6	2.06	0.79	1481.
100	4.98	32.69	99	25.87	214.7	2.62	1.29	1469.
125	4.65	32.97	124	26.13	190.5	3.14	1.87	1469.
150	5.05	33.51	149	26.51	154.6	3.56	2.47	1472.
175	5.11	33.73	174	26.68	138.8	3.93	3.07	1473.
200	4.95	33.77	199	26.73	134.3	4.27	3.73	1472.
225	4.67	33.81	223	26.80	128.5	4.60	4.44	1472.
250	4.48	33.85	248	26.85	123.9	4.91	5.20	1471.
300	4.05	33.89	298	26.92	116.7	5.51	6.88	1470.
400	3.86	34.02	397	27.05	106.0	6.62	10.82	1471.
500	3.67	34.12	496	27.14	97.1	7.63	15.45	1472.
600	3.51	34.18	595	27.21	91.4	8.57	20.73	1473.
800	3.23	34.30	793	27.33	81.0	10.29	32.96	1476.
1000	2.93	34.38	990	27.42	73.5	11.84	47.08	1478.
1200	2.65	34.43	1188	27.49	67.5	13.25	62.85	1480.



OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 9- 9

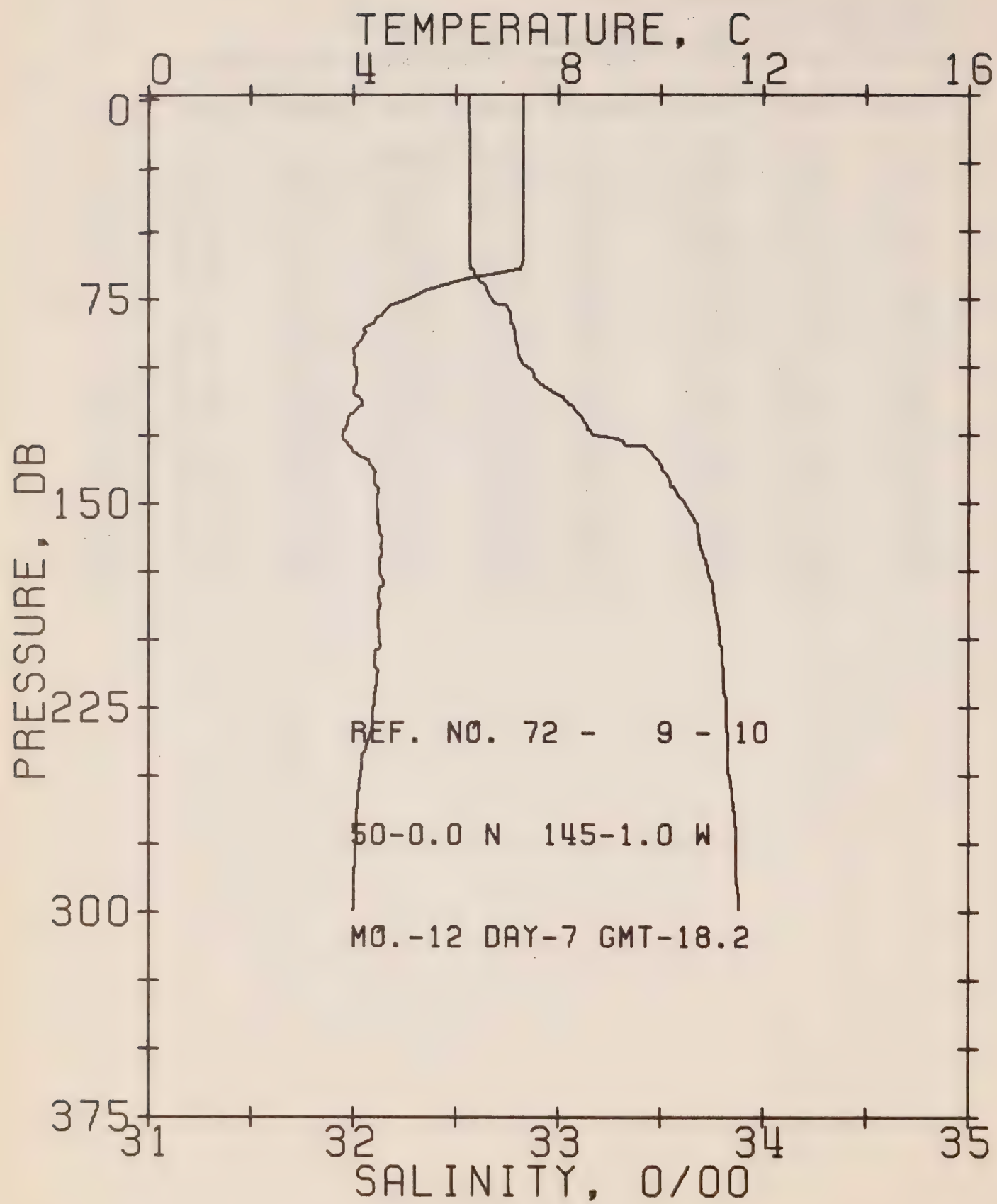
DATE 5/12/72

POSITION 49-58.0N, 144-58.0W

GMT 23.2

RESULTS OF STP CAST 204 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. FN	SCUND
0	7.38	32.55	0	25.46	252.5	0.0	0.0	1477.
10	7.35	32.56	10	25.48	251.8	0.25	0.01	1477.
20	7.35	32.56	20	25.48	251.9	0.50	0.05	1478.
30	7.35	32.56	30	25.48	252.1	0.76	0.12	1478.
50	7.34	32.56	50	25.48	252.2	1.26	0.32	1478.
75	6.08	32.59	75	25.67	234.4	1.89	0.72	1473.
100	4.16	32.83	99	26.07	195.8	2.40	1.13	1466.
125	4.34	33.25	124	26.39	166.2	2.86	1.70	1468.
150	4.82	33.70	149	26.69	138.1	3.22	2.20	1471.
175	4.79	33.78	174	26.76	131.8	3.56	2.76	1471.
200	4.56	33.81	199	26.81	127.2	3.88	3.38	1471.
225	4.35	33.94	223	26.85	123.0	4.19	4.06	1470.
250	4.17	33.85	248	26.88	120.5	4.50	4.79	1470.
300	4.07	33.91	298	26.94	115.2	5.08	6.44	1471.
400	3.81	34.03	397	27.06	104.5	6.18	10.33	1471.
500	3.66	34.12	496	27.15	96.9	7.18	14.92	1472.
600	3.47	34.20	595	27.23	89.8	8.11	20.12	1473.
800	3.16	34.30	793	27.34	80.5	9.81	32.26	1475.
1000	2.83	34.39	990	27.43	71.9	11.33	46.17	1477.
1200	2.60	34.43	1188	27.49	67.3	12.73	61.77	1480.



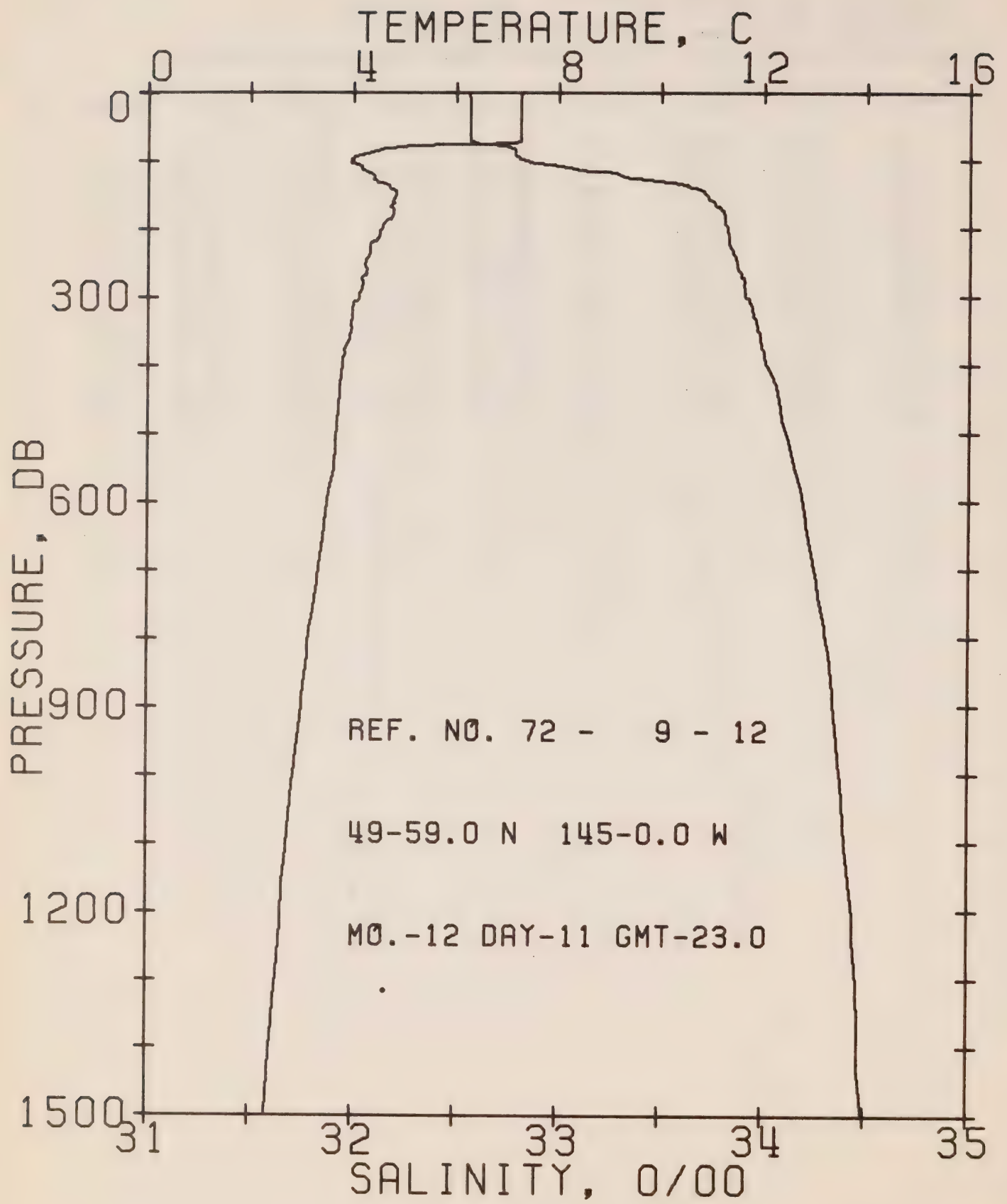
OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 9- 10 DATE 7/12/72

POSITION 50- 0.0N, 145- 1.0W GMT 18.2

RESULTS OF STD CAST 129 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	7.30	32.56	0	25.48	250.8	0.0	0.0	1477.
10	7.30	32.56	10	25.49	250.8	0.25	0.01	1477.
20	7.30	32.57	20	25.49	250.6	0.50	0.05	1477.
30	7.30	32.57	30	25.49	250.6	0.75	0.11	1478.
50	7.30	32.57	50	25.49	250.9	1.25	0.32	1478.
75	5.04	32.67	75	25.85	216.7	1.86	0.70	1469.
100	4.04	32.85	99	26.10	193.2	2.36	1.15	1466.
125	3.79	33.17	124	26.38	166.8	2.81	1.66	1466.
150	4.46	33.62	149	26.67	140.0	3.18	2.18	1469.
175	4.52	33.73	174	26.75	132.5	3.52	2.74	1470.
200	4.52	33.79	199	26.79	128.3	3.84	3.36	1471.
225	4.37	33.82	223	26.83	124.7	4.16	4.05	1471.
250	4.12	33.83	248	26.87	121.3	4.47	4.79	1470.



OFFSHORE OCEANOGRAPHY GROUP

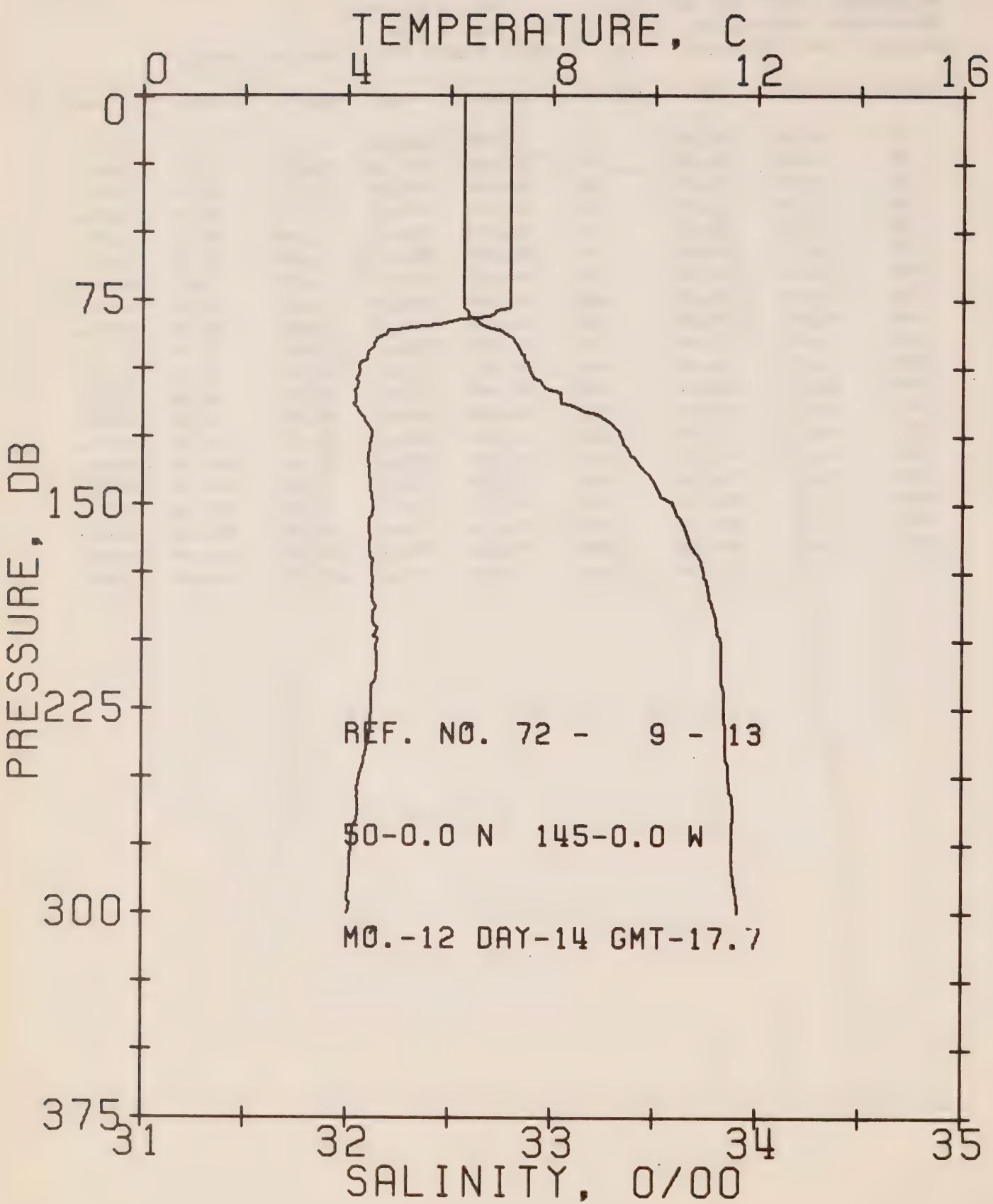
REFERENCE NO. 72- 9- 12

DATE 11/12/72

POSITION 49-59.0N, 145- 0.0W GMT 23.0

RESULTS OF STP CAST 170 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	7.31	32.56	0	25.48	250.9	0.0	0.0	1477.
10	7.25	32.57	10	25.50	249.9	0.25	0.01	1477.
20	7.25	32.57	20	25.50	249.8	0.50	0.05	1477.
30	7.25	32.57	30	25.50	250.0	0.75	0.11	1477.
50	7.25	32.57	50	25.50	250.2	1.25	0.32	1478.
75	6.75	32.61	75	25.60	241.3	1.88	0.72	1476.
100	3.96	32.83	99	26.09	193.5	2.39	1.17	1465.
125	4.36	33.36	124	26.47	158.2	2.83	1.67	1468.
150	4.81	33.71	149	26.70	136.7	3.19	2.18	1471.
175	4.78	33.80	174	26.77	130.1	3.52	2.73	1471.
200	4.53	33.82	199	26.82	126.1	3.84	3.34	1471.
225	4.32	33.83	223	26.85	123.2	4.15	4.02	1470.
250	4.22	33.87	248	26.89	119.7	4.46	4.75	1470.
300	4.11	33.91	298	26.93	115.9	5.05	6.40	1471.
400	3.78	34.01	397	27.05	105.7	6.14	10.31	1471.
500	3.66	34.11	496	27.14	98.0	7.16	14.95	1472.
600	3.48	34.19	595	27.22	90.7	8.10	20.24	1473.
800	3.13	34.30	793	27.34	79.8	9.81	32.40	1475.
1000	2.85	34.38	990	27.43	72.8	11.33	46.35	1478.
1200	2.62	34.44	1188	27.49	67.0	12.74	62.05	1480.



OFFSHORE OCEANOGRAPHY GROUP

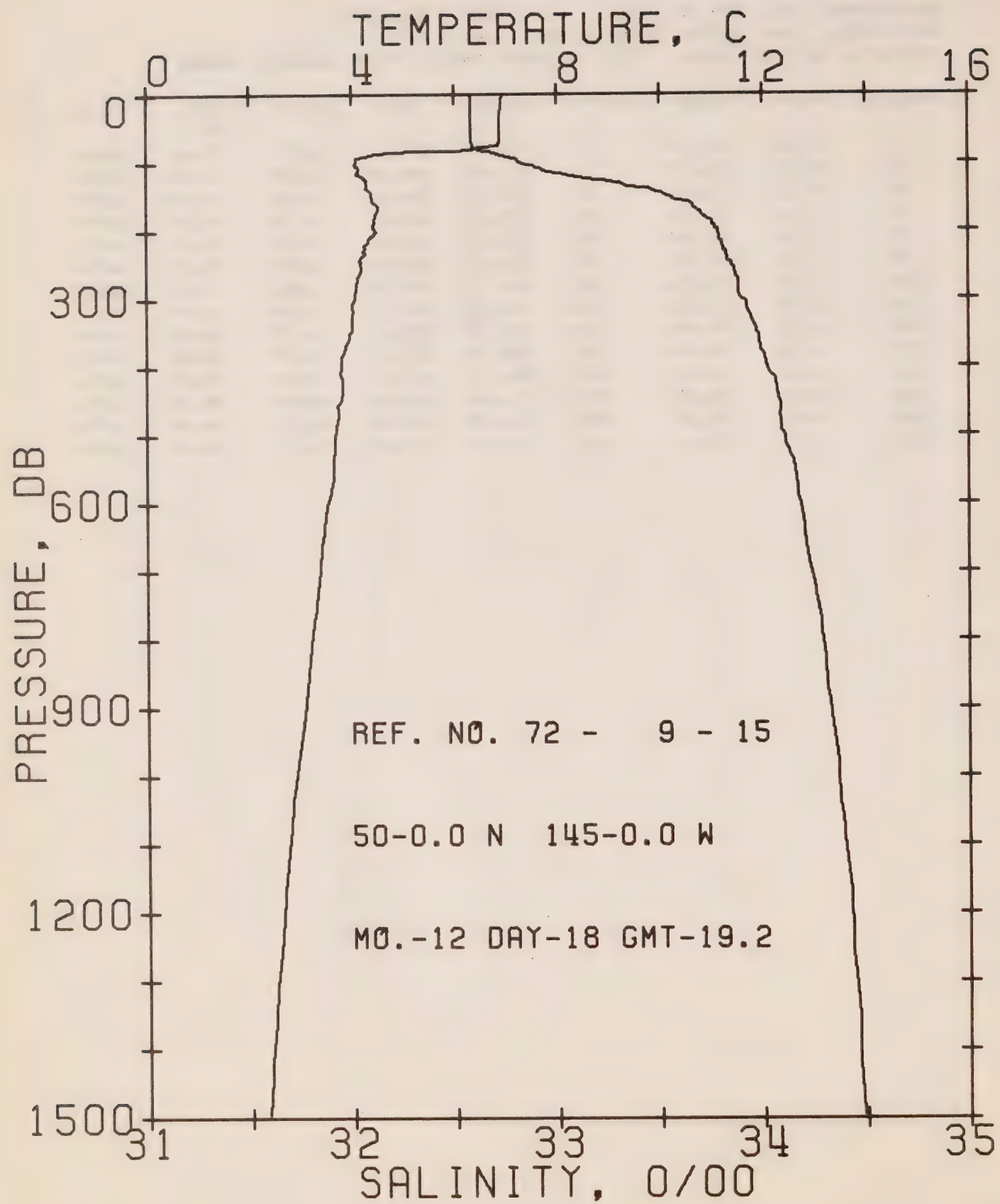
REFERENCE NO. 72- 9- 13

DATE 14/12/72

POSITION 50- 0.0N, 145- 0.0W GMT 17.7

RESULTS OF STD CAST 123 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	7.16	32.57	0	25.51	248.2	0.0	0.0	1476.
10	7.16	32.57	10	25.51	248.5	0.25	0.01	1477.
20	7.16	32.57	20	25.51	248.6	0.50	0.05	1477.
30	7.16	32.57	30	25.51	248.8	0.75	0.11	1477.
50	7.16	32.57	50	25.51	249.1	1.24	0.32	1477.
75	7.16	32.57	75	25.51	249.4	1.87	0.71	1478.
100	4.23	32.88	99	26.11	192.4	2.41	1.19	1467.
125	4.48	33.33	124	26.44	161.3	2.85	1.70	1469.
150	4.51	33.59	149	26.64	142.7	3.23	2.23	1470.
175	4.48	33.74	174	26.76	131.4	3.57	2.80	1470.
200	4.57	33.82	199	26.82	126.3	3.89	3.41	1471.
225	4.49	33.84	223	26.84	124.4	4.21	4.09	1471.
250	4.23	33.86	248	26.88	120.5	4.51	4.83	1470.
300	4.01	33.91	293	26.94	114.8	5.10	6.48	1470.



OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72- 9- 15

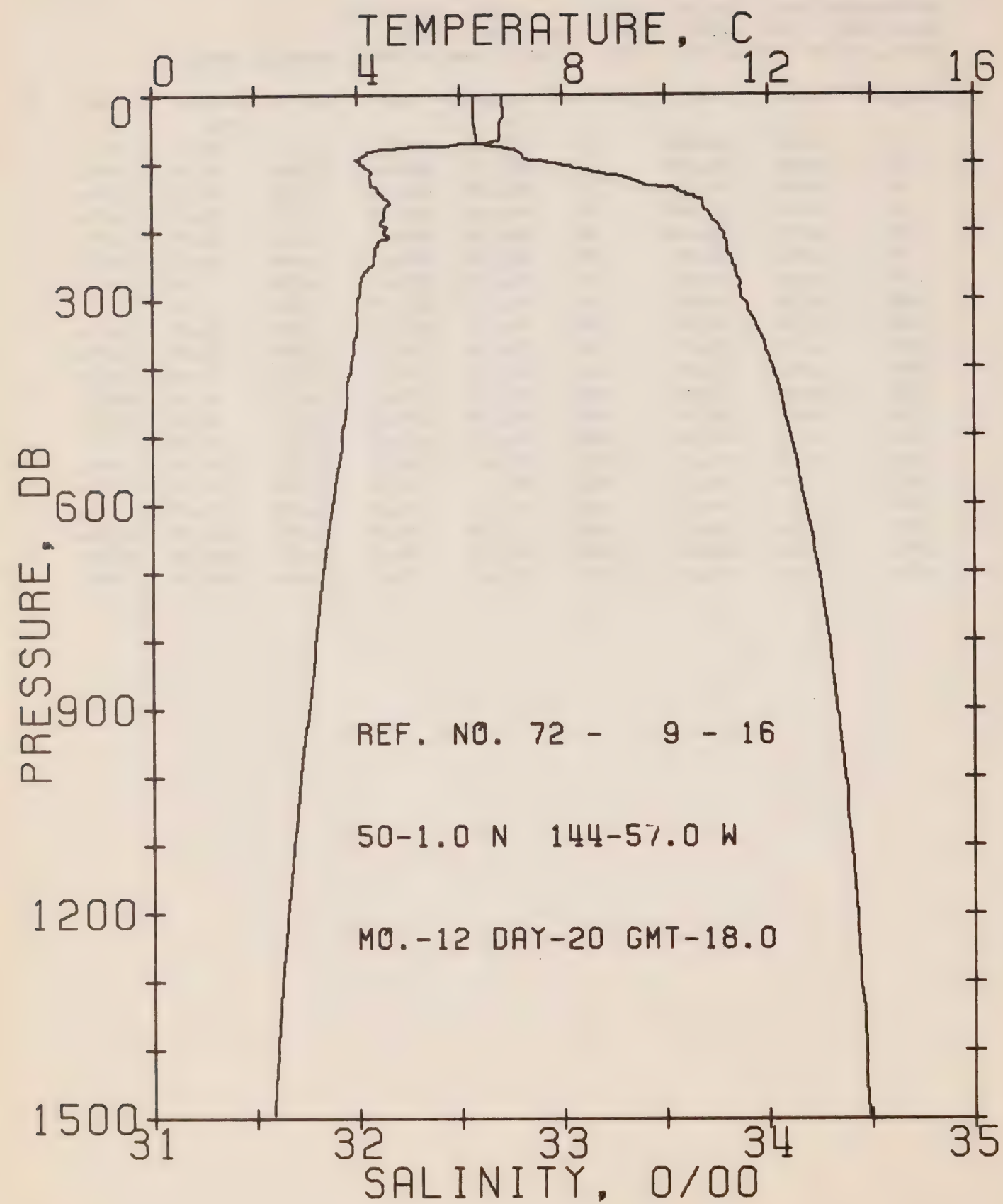
DATE 18/12/72

POSITION 50- 0.0N, 145- 0.0W

GMT 19.2

RESULTS OF STP CAST 191 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	6.92	32.57	0	25.54	245.2	0.0	0.0	1476.
10	6.90	32.58	10	25.55	244.5	0.24	0.01	1476.
20	6.90	32.58	20	25.55	244.6	0.49	0.05	1476.
30	6.89	32.58	30	25.55	244.6	0.73	0.11	1476.
50	6.89	32.58	50	25.55	244.8	1.22	0.31	1476.
75	6.86	32.59	75	25.57	244.1	1.84	0.70	1477.
100	4.08	32.82	99	26.07	195.8	2.38	1.18	1466.
125	4.29	33.17	124	26.33	171.4	2.84	1.71	1468.
150	4.38	33.54	149	26.61	145.1	3.23	2.26	1469.
175	4.47	33.70	174	26.73	134.2	3.58	2.83	1470.
200	4.46	33.78	199	26.79	128.3	3.90	3.45	1470.
225	4.28	33.81	223	26.84	124.5	4.22	4.14	1470.
250	4.15	33.95	248	26.88	120.5	4.53	4.88	1470.
300	4.03	33.89	298	26.93	116.3	5.12	6.54	1470.
400	3.78	34.02	397	27.05	105.1	6.22	10.46	1471.
500	3.66	34.10	496	27.13	98.3	7.23	15.10	1472.
600	3.51	34.18	595	27.21	91.9	8.18	20.42	1473.
800	3.18	34.29	793	27.32	81.8	9.92	32.76	1476.
1000	2.88	34.36	990	27.41	74.2	11.48	47.04	1478.
1200	2.62	34.42	1188	27.48	67.8	12.89	62.90	1480.



OFFSHORE OCEANOGRAPHY GROUP

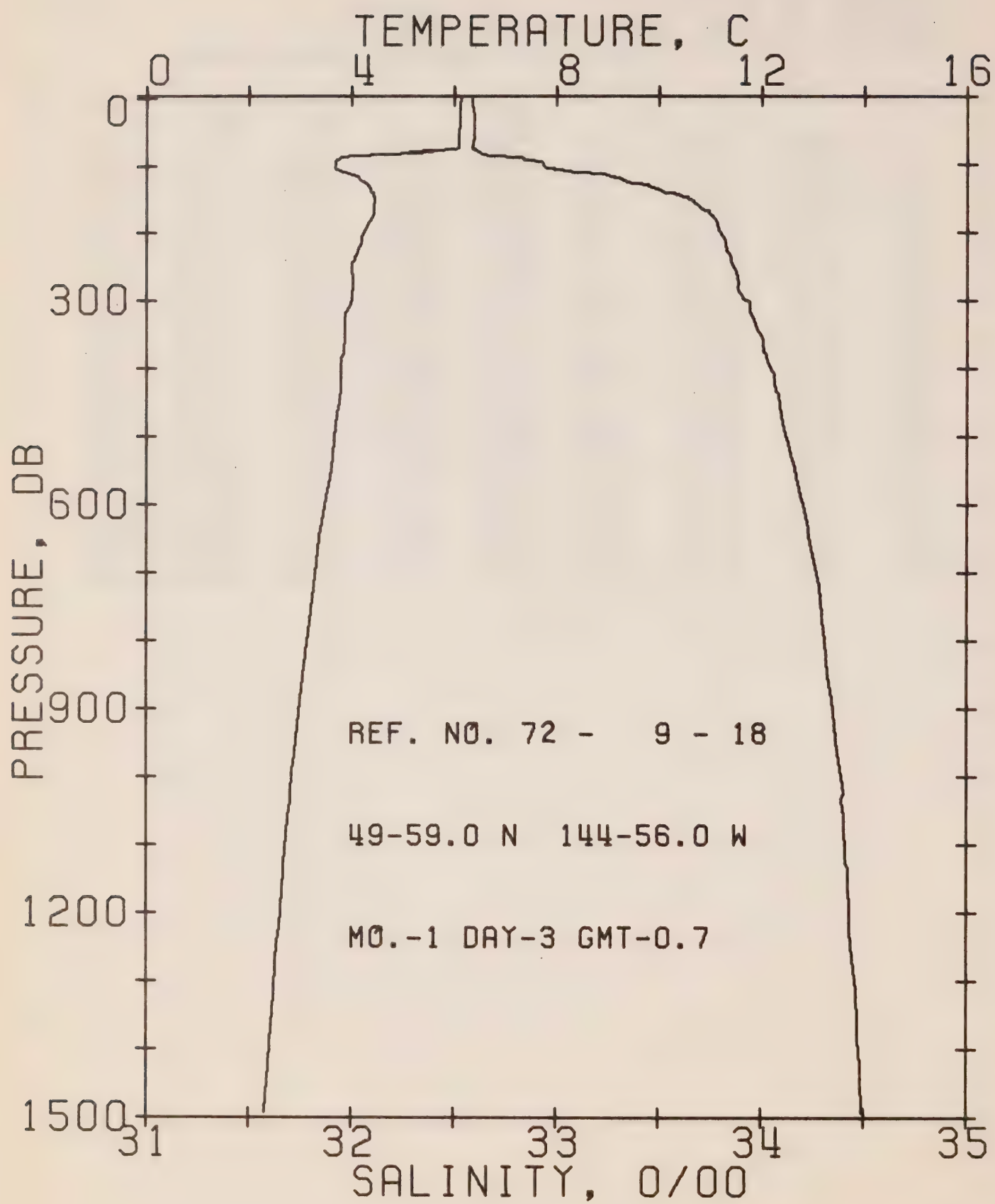
REFERENCE NO. 72- 9- 16

DATE 20/12/72

POSITION 50- 1.0N. 144-57.0W. GMT 18.0

RESULTS OF STP CAST 169 POINTS TAKEN FROM ANALOG TRACE

PRESS.	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	6.84	32.56	0	25.54	244.9	0.0	0.0	1475.
10	6.84	32.57	10	25.55	244.5	0.24	0.01	1475.
20	6.85	32.57	20	25.55	244.6	0.49	0.05	1476.
30	6.85	32.57	30	25.55	244.9	0.73	0.11	1476.
50	6.78	32.57	50	25.56	243.9	1.22	0.31	1476.
75	5.73	32.67	75	25.77	224.3	1.83	0.70	1472.
100	4.06	32.93	99	26.16	187.3	2.33	1.14	1466.
125	4.26	33.33	124	26.46	159.4	2.76	1.63	1468.
150	4.52	33.64	149	26.68	139.1	3.13	2.15	1470.
175	4.52	33.71	174	26.73	133.8	3.47	2.72	1470.
200	4.53	33.77	199	26.78	129.5	3.80	3.35	1471.
225	4.35	33.80	223	26.82	126.0	4.12	4.04	1470.
250	4.29	33.83	248	26.85	123.3	4.43	4.79	1471.
300	4.01	33.87	298	26.91	117.6	5.03	6.47	1470.
400	3.87	34.02	397	27.04	106.1	6.14	10.43	1472.
500	3.67	34.11	496	27.13	98.1	7.16	15.09	1472.
600	3.49	34.18	595	27.21	91.7	8.11	20.41	1473.
800	3.17	34.29	793	27.33	81.0	9.83	32.64	1475.
1000	2.85	34.37	990	27.42	73.4	11.37	46.78	1478.
1200	2.61	34.43	1188	27.49	67.5	12.78	62.56	1480.



OFFSHORE OCEANOGRAPHY GROUP

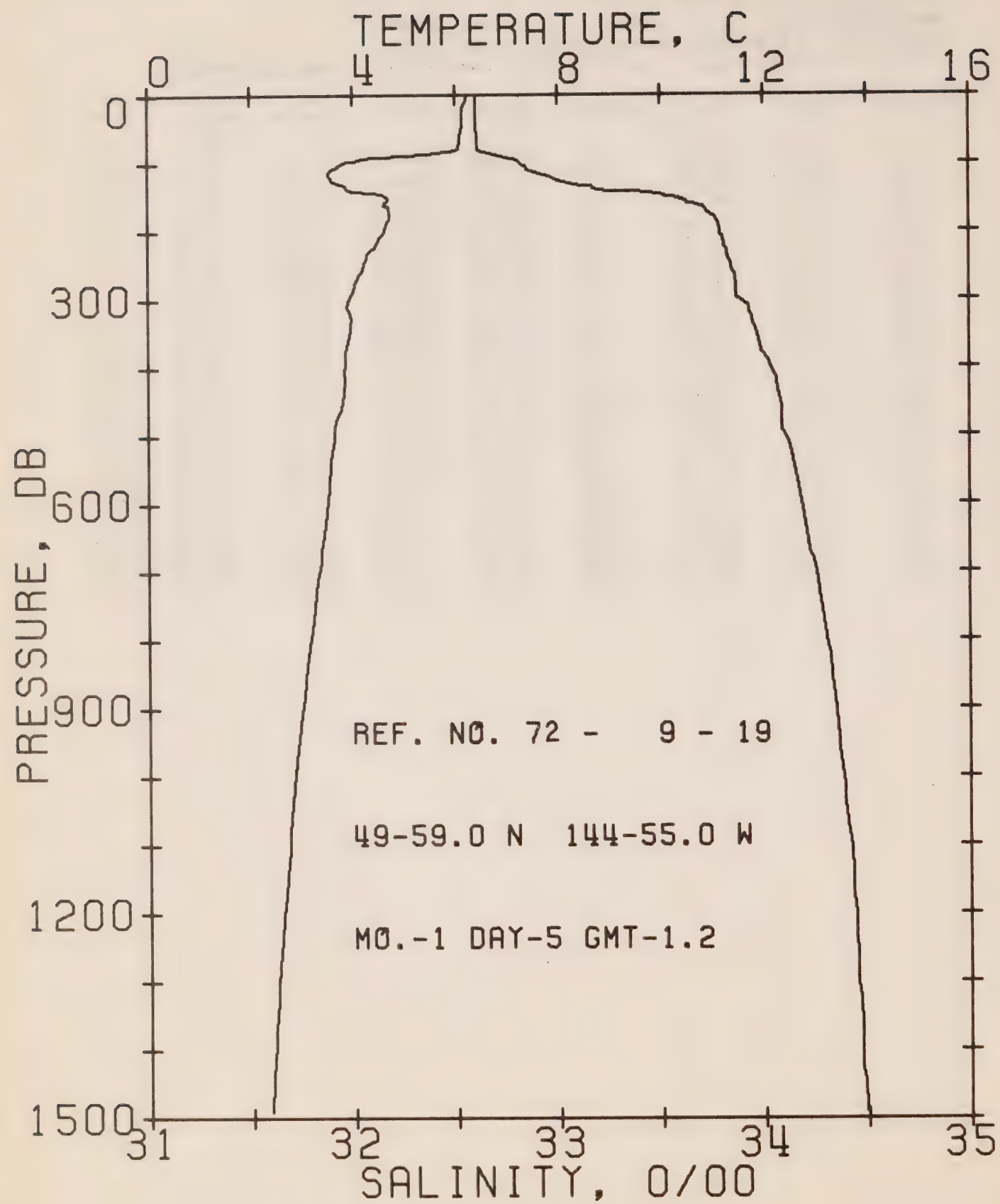
REFERENCE NO. 72- 9- 18

DATE 3/ 1/73

POSITION 49-59.0N. 144-56.0W GMT 0.7

RESULTS OF STD. CAST 150 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	6.18	32.59	0	25.65	234.6	0.0	0.0	1473.
10	6.10	32.59	10	25.66	234.0	0.23	0.01	1472.
20	6.10	32.59	20	25.67	233.7	0.47	0.05	1473.
30	6.10	32.60	30	25.67	233.4	0.70	0.11	1473.
50	6.09	32.60	50	25.67	233.6	1.17	0.30	1473.
75	6.09	32.59	75	25.67	234.4	1.75	0.67	1473.
100	3.68	32.93	99	26.20	183.7	2.28	1.13	1464.
125	4.20	33.34	124	26.47	158.0	2.70	1.62	1468.
150	4.46	33.64	149	26.68	138.4	3.07	2.14	1469.
175	4.41	33.75	174	26.77	129.9	3.41	2.69	1470.
200	4.24	33.79	199	26.83	125.0	3.73	3.30	1470.
225	4.11	33.83	223	26.87	121.4	4.03	3.97	1469.
250	4.01	33.86	248	26.90	118.1	4.33	4.69	1469.
300	4.00	33.92	293	26.95	114.2	4.92	6.32	1470.
400	3.79	34.04	397	27.07	103.4	5.99	10.17	1471.
500	3.66	34.12	496	27.14	97.4	7.00	14.76	1472.
600	3.47	34.20	595	27.23	89.8	7.93	20.00	1473.
800	3.13	34.31	793	27.35	79.5	9.62	31.96	1475.
1000	2.81	34.39	990	27.44	71.8	11.13	45.85	1477.
1200	2.60	34.43	1188	27.49	67.4	12.52	61.42	1480.



OFFSHORE OCEANOGRAPHY GROUP

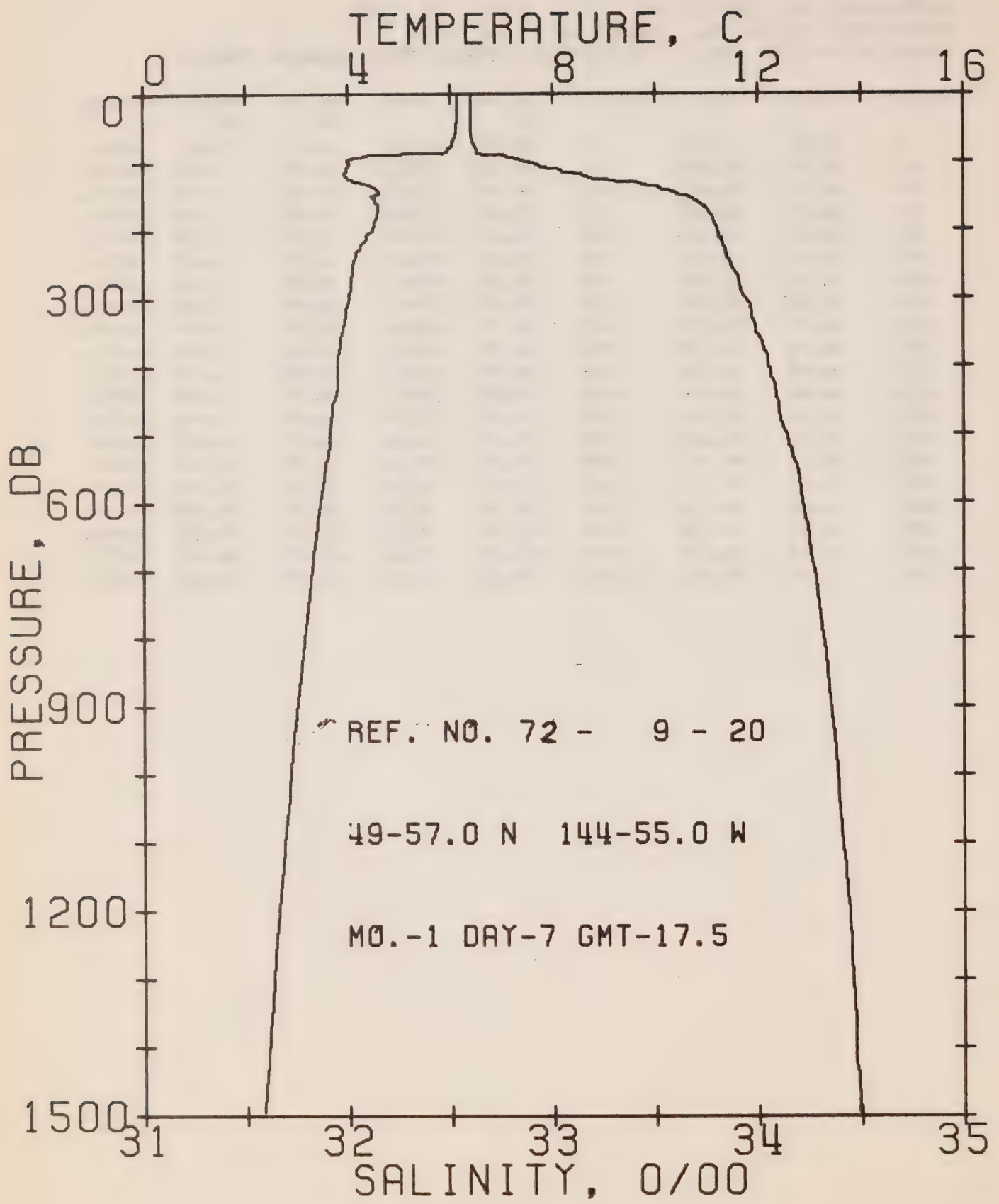
REFERENCE NO. 72- 9- 19

DATE 5/ 1/73

POSITION 49-59.0N, 144-55.0W GMT 1.2

RESULTS OF STP CAST 152 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	6.21	32.59	0	25.65	234.9	0.0	0.0	1473.
10	6.20	32.60	10	25.66	234.4	0.23	0.01	1473.
20	6.14	32.60	20	25.67	233.8	0.47	0.05	1473.
30	6.12	32.60	30	25.67	233.8	0.70	0.11	1473.
50	6.11	32.60	50	25.67	233.8	1.17	0.30	1473.
75	6.06	32.61	75	25.68	232.7	1.75	0.67	1473.
100	3.87	32.81	99	26.09	194.3	2.30	1.15	1465.
125	3.59	32.99	124	26.25	178.7	2.76	1.69	1464.
150	4.63	33.52	149	26.57	149.2	3.18	2.26	1470.
175	4.71	33.73	174	26.73	134.2	3.52	2.84	1471.
200	4.60	33.79	199	26.79	129.2	3.85	3.47	1471.
225	4.41	33.81	223	26.82	125.7	4.17	4.16	1471.
250	4.20	33.84	248	26.87	121.6	4.48	4.90	1470.
300	3.91	33.88	298	26.93	116.1	5.07	6.57	1470.
400	3.83	34.03	397	27.06	104.5	6.17	10.48	1471.
500	3.62	34.10	496	27.13	98.0	7.18	15.11	1472.
600	3.48	34.18	595	27.21	91.2	8.12	20.38	1473.
800	3.14	34.30	793	27.34	80.0	9.83	32.53	1475.
1000	2.83	34.38	990	27.43	72.2	11.35	46.43	1477.
1200	2.60	34.44	1188	27.50	66.6	12.73	61.92	1480.



OFFSHORE OCEANOGRAPHY GROUP

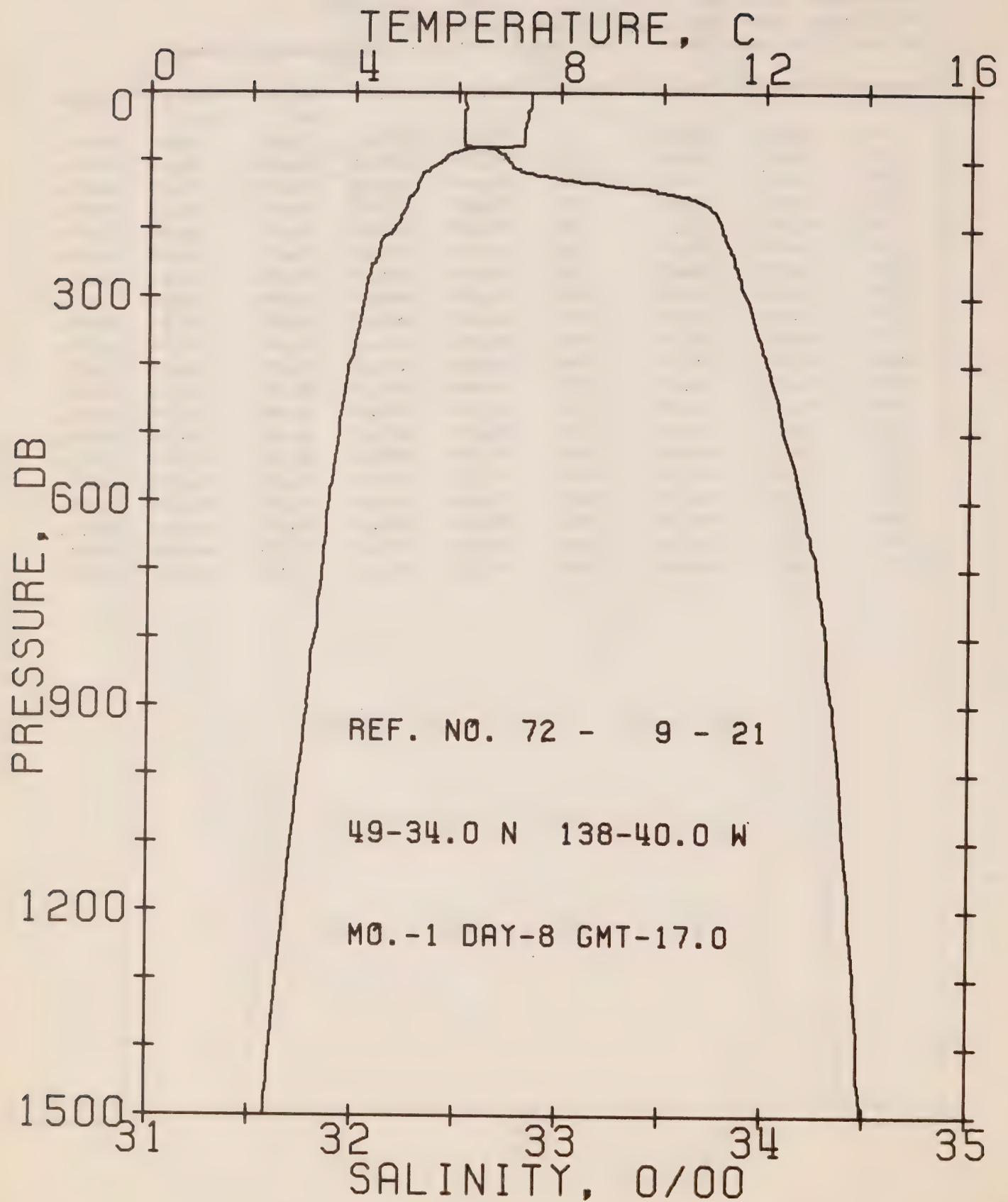
REFERENCE NO. 72- 9- 20

DATE 7/ 1/73

POSITION 49-57.0N, 144-55.0W GMT 17.5

RESULTS OF STP CAST 182 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SCUND
0	6.12	32.59	0	25.66	233.8	0.0	0.0	1472.
10	6.12	32.60	10	25.67	233.4	0.23	0.01	1473.
20	6.12	32.60	20	25.67	233.6	0.47	0.05	1473.
30	6.12	32.60	30	25.67	233.7	0.70	0.11	1473.
50	6.11	32.60	50	25.67	233.8	1.17	0.30	1473.
75	6.03	32.61	75	25.69	232.0	1.75	0.67	1473.
100	3.99	32.87	99	26.12	191.2	2.29	1.15	1466.
125	4.00	33.20	124	26.38	166.6	2.74	1.66	1466.
150	4.54	33.63	149	26.67	140.0	3.12	2.19	1470.
175	4.57	33.75	174	26.76	131.2	3.45	2.74	1470.
200	4.48	33.80	199	26.81	127.2	3.78	3.36	1471.
225	4.23	33.83	223	26.86	122.3	4.09	4.03	1470.
250	4.09	33.87	248	26.90	118.6	4.39	4.76	1470.
300	4.03	33.93	298	26.96	113.3	4.97	6.38	1470.
400	3.78	34.05	397	27.08	102.8	6.04	10.20	1471.
500	3.62	34.14	496	27.16	95.5	7.03	14.76	1472.
600	3.44	34.22	595	27.24	88.4	7.95	19.89	1473.
800	3.13	34.32	793	27.35	78.8	9.62	31.75	1475.
1000	2.85	34.38	990	27.43	72.2	11.13	45.56	1478.
1200	2.62	34.44	1188	27.50	66.7	12.52	61.15	1480.



OFFSHORE OCEANOGRAPHY GROUP

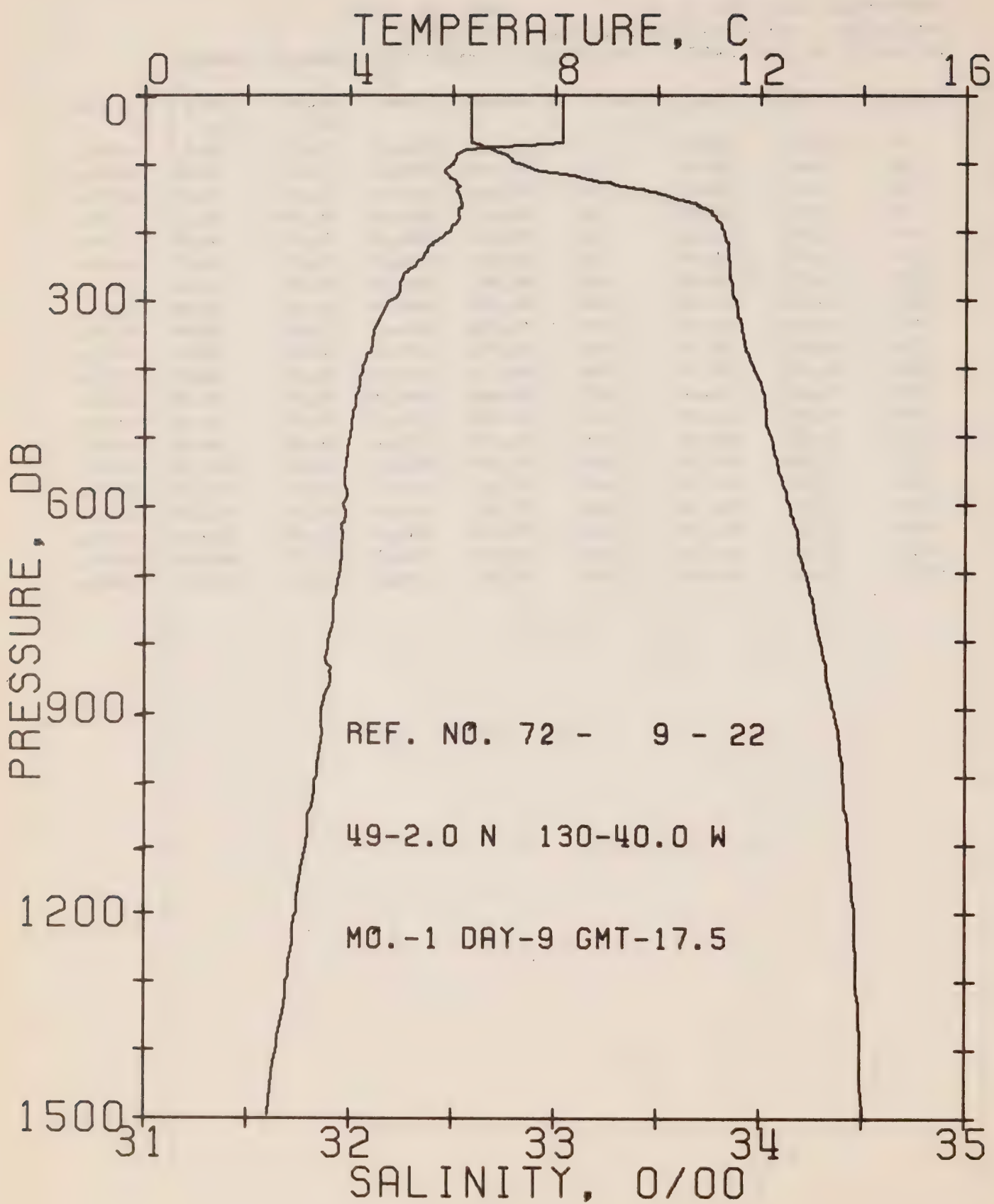
REFERENCE NO. 72- 9- 21

DATE 8/ 1/73

POSITION 49-34.0N, 138-40.0W GMT 17.0

RESULTS OF STD. CAST 186 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	7.43	32.53	0	25.44	254.7	0.0	0.0	1477.
10	7.42	32.53	10	25.44	255.0	0.25	0.01	1478.
20	7.42	32.54	20	25.45	254.6	0.51	0.05	1478.
30	7.35	32.53	30	25.45	254.3	0.76	0.12	1478.
50	7.30	32.53	50	25.46	254.0	1.27	0.32	1478.
75	7.28	32.53	75	25.46	254.0	1.91	0.73	1478.
100	5.71	32.74	99	25.83	219.2	2.48	1.24	1473.
125	5.26	32.98	124	26.07	196.4	3.01	1.85	1471.
150	5.10	33.56	149	26.54	151.7	3.45	2.45	1472.
175	4.93	33.75	174	26.71	135.9	3.80	3.04	1472.
200	4.75	33.79	199	26.77	130.8	4.13	3.67	1472.
225	4.47	33.82	223	26.82	126.0	4.45	4.37	1471.
250	4.40	33.85	248	26.86	123.0	4.77	5.12	1471.
300	4.20	33.90	298	26.92	117.4	5.36	6.80	1471.
400	3.89	34.01	397	27.03	106.9	6.48	10.79	1472.
500	3.70	34.09	496	27.12	99.5	7.51	15.49	1473.
600	3.50	34.18	595	27.21	91.4	8.46	20.82	1473.
800	3.23	34.30	793	27.33	81.1	10.18	33.04	1476.
1000	2.95	34.37	990	27.41	74.2	11.74	47.31	1478.
1200	2.66	34.42	1188	27.48	68.6	13.17	63.31	1480.



OFFSHORE OCEANOGRAPHY GROUP

REFERENCE NO. 72-9-22

DATE 9/ 1/73

POSITION 49- 2.0N, 130-40.0W GMT 17.5

RESULTS OF STD CAST 204 POINTS TAKEN FROM ANALOG TRACE

PRESS	TEMP	SAL	DEPTH	SIGMA T	SVA	DELTA D	POT. EN	SOUND
0	8.13	32.57	0	25.37	261.2	0.0	0.0	1480.
10	8.12	32.59	10	25.39	260.0	0.26	0.01	1480.
20	8.13	32.59	20	25.39	260.2	0.52	0.05	1481.
30	8.13	32.59	30	25.39	260.4	0.78	0.12	1481.
50	8.13	32.59	50	25.39	260.7	1.30	0.33	1481.
75	6.94	32.65	75	25.60	240.6	1.95	0.74	1477.
100	6.01	32.81	99	25.85	217.4	2.51	1.24	1474.
125	6.01	33.17	124	26.13	190.6	3.02	1.83	1475.
150	6.14	33.56	149	26.42	163.6	3.46	2.45	1476.
175	6.11	33.76	174	26.58	148.6	3.85	3.08	1477.
200	5.94	33.82	199	26.65	142.4	4.21	3.78	1477.
225	5.50	33.84	223	26.72	135.9	4.56	4.53	1475.
250	5.25	33.85	248	26.76	132.5	4.90	5.34	1475.
300	4.83	33.87	298	26.83	126.5	5.54	7.16	1474.
400	4.25	33.96	397	26.96	114.1	6.74	11.43	1473.
500	3.99	34.05	496	27.05	106.0	7.84	16.43	1474.
600	3.87	34.14	595	27.14	98.7	8.86	22.17	1475.
800	3.57	34.29	793	27.29	85.6	10.71	35.33	1477.
1000	3.34	34.40	990	27.40	76.4	12.33	50.13	1480.
1200	2.93	34.46	1188	27.48	68.8	13.78	66.34	1481.

SURFACE TEMPERATURE AND SALINITY OBSERVATIONS

(P-72-9)

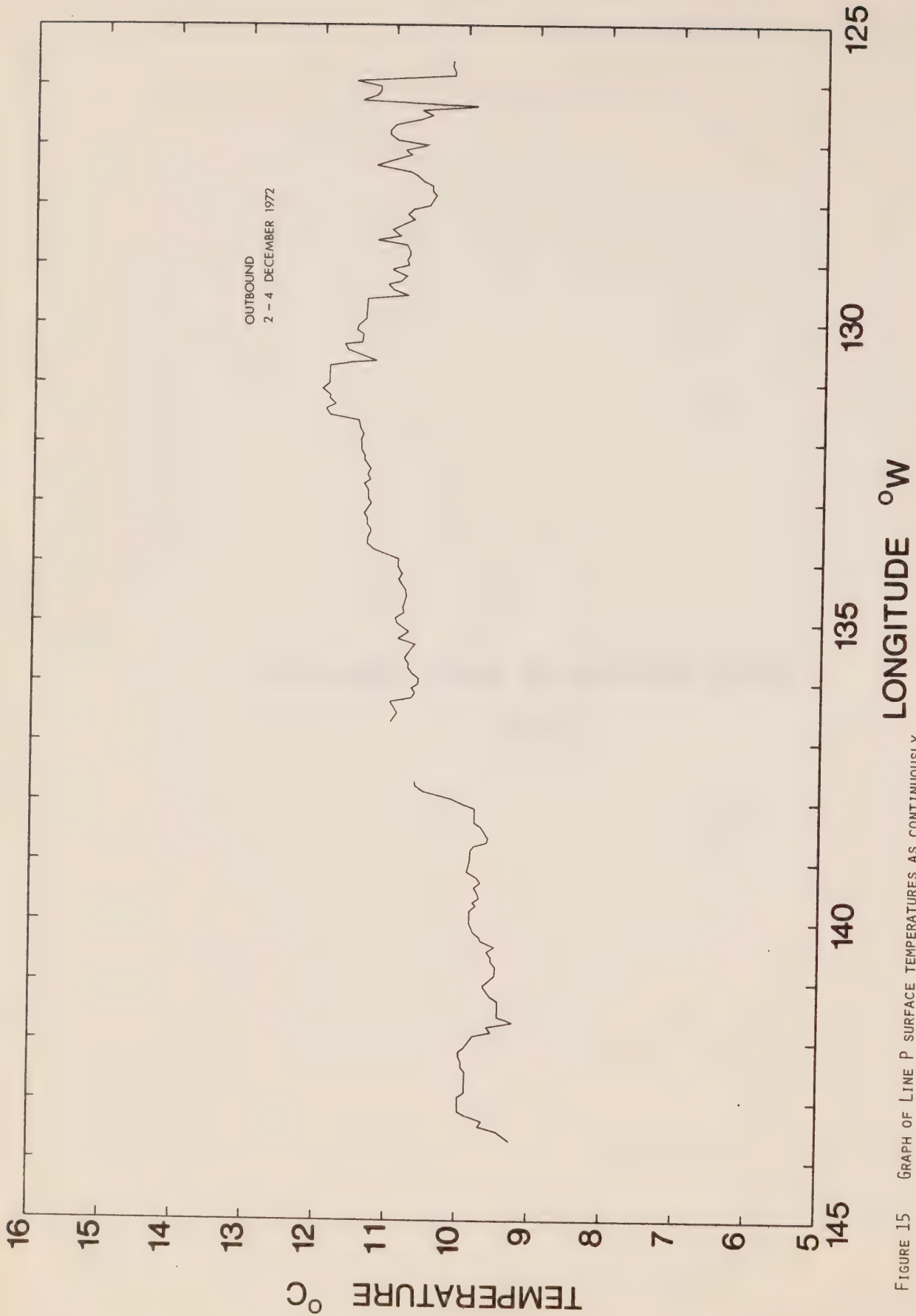


FIGURE 15 GRAPH OF LINE P SURFACE TEMPERATURES AS CONTINUOUSLY RECORDED FROM A PROBE LOCATED AT THE ENGINE ROOM INTAKE (APPROXIMATELY 3 METERS BELOW THE SURFACE), P-72-9.

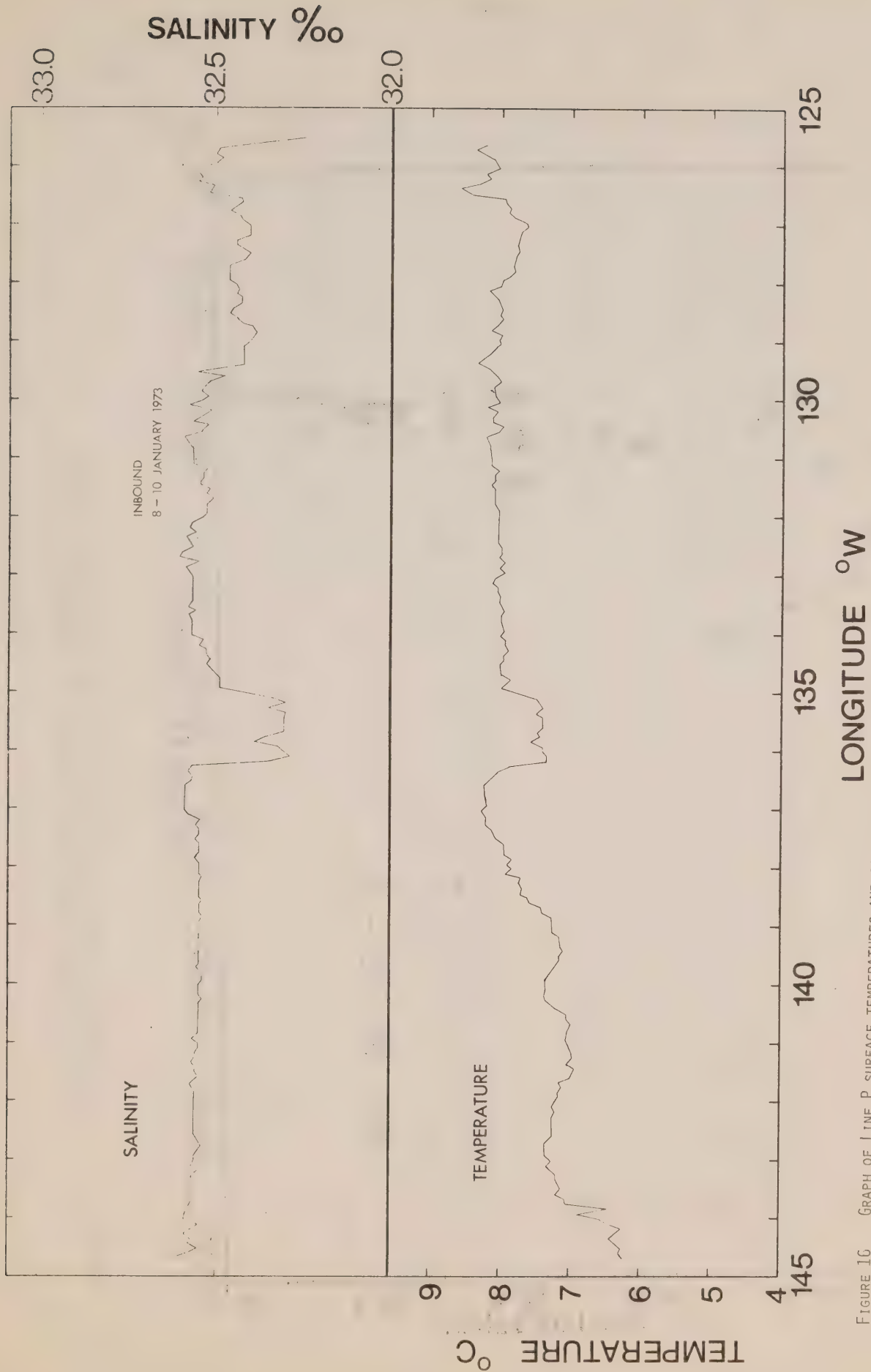


FIGURE 16 GRAPH OF LINE P SURFACE TEMPERATURES AND SALINITIES
AS CONTINUOUSLY RECORDED FROM PROBES IN THE SEAWATER
LAB, P-72-9.

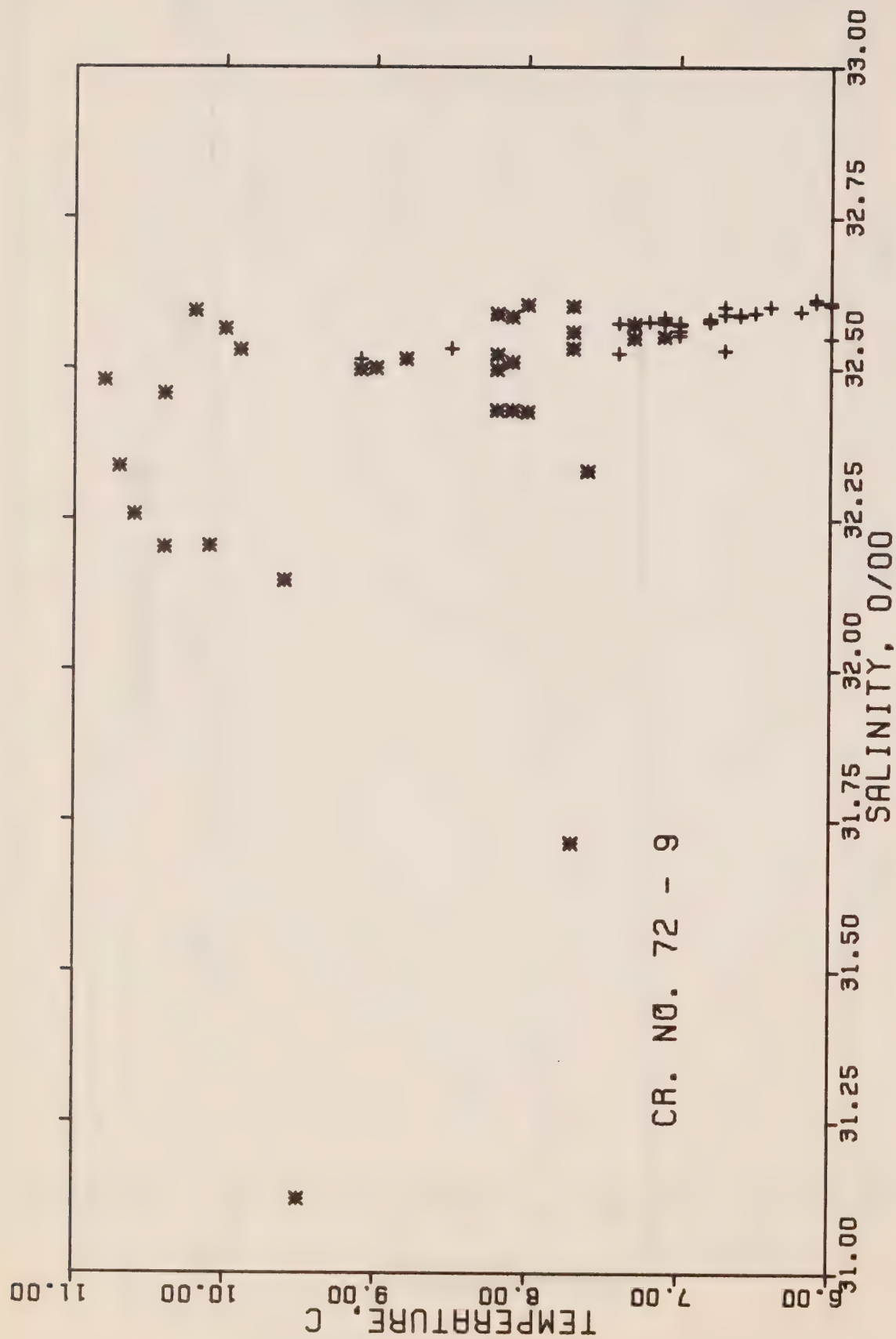


Figure 17 T-S plot of surface temperature and salinity observations on Line P (asterisks) and at Station P (pluses). P-72-9.

SURFACE SALINITY AND TEMPERATURE OBSERVATIONS
CRUISE REFERENCE NUMBER 72- 9

DATE/TIME				SALINITY	TEMP	LONGITUDE
YR	MO	DAY	GMT	0/00	C	WEST
72	12	2	240	31.123	9.5	125-33
72	12	2	545	32.257	10.6	126- 0
72	12	2	730	32.203	10.4	126-40
72	12	2	1140	32.147	9.6	127-40
72	12	2	1600	32.205	10.1	128-40
72	12	3	0	32.338	10.7	130-40
72	12	3	410	32.481	10.8	131-40
72	12	3	725	32.457	10.4	132-40
72	12	3	1915	32.565	10.0	135-40
72	12	3	2250	32.594	10.2	136-40
72	12	4	15	32.531	9.9	137-40
72	12	4	310	32.501	9.0	138-40
72	12	4	605	32.497	9.1	139-40
72	12	4	855	32.515	8.8	140-40
72	12	4	1320	32.514	9.1	142-40
72	12	4	1830	32.532	8.5	143-40
72	12	5	0	32.525	7.4	145- 0
72	12	6	0	32.574	7.3	ON STATION
72	12	7	0	32.574	7.1	ON STATION
72	12	8	0	32.578	7.2	ON STATION
72	12	9	0	32.576	7.4	ON STATION
72	12	10	0	32.584	7.1	ON STATION
72	12	11	0	32.577	7.1	ON STATION
72	12	12	0	32.583	7.1	ON STATION
72	12	13	0	32.573	7.0	ON STATION
72	12	14	0	32.575	7.0	ON STATION
72	12	15	0	32.576	7.0	ON STATION
72	12	16	0	32.582	6.8	ON STATION
72	12	17	0	32.577	6.8	ON STATION
72	12	18	0	32.578	6.8	ON STATION
72	12	19	0	32.588	6.6	ON STATION
72	12	20	0	32.590	6.7	ON STATION
72	12	21	0	32.602	6.7	ON STATION
72	12	22	0	32.589	6.6	ON STATION
72	12	23	0	32.593	6.5	ON STATION
72	12	24	0	32.602	6.4	ON STATION
72	12	25	0	0.0	6.8	ON STATION
72	12	31	0	0.0	9.2	ON STATION
73	1	1	0	32.595	6.2	ON STATION
73	1	2	0	32.609	6.0	ON STATION
73	1	3	0	32.614	6.1	ON STATION
73	1	4	0	32.608	6.0	ON STATION
73	1	5	0	32.610	6.1	ON STATION
73	1	6	0	32.604	6.0	ON STATION
73	1	7	0	32.549	6.0	ON STATION

SURFACE SALINITY AND TEMPERATURE OBSERVATIONS
CRUISE REFERENCE NUMBER 72- 9

DATE/TIME				SALINITY	TEMP	LONGITUDE
YR	MO	DY	GMT	0/00	C	WEST
73	1	7	0	32.549	6.0	ON STATION
73	1	8	0	32.531	6.7	143-40
73	1	8	345	32.556	7.0	142-40
73	1	8	750	32.562	7.0	141-40
73	1	8	1045	32.552	7.1	140-40
73	1	8	1400	32.550	7.3	139-40
73	1	8	1640	32.572	7.3	138-40
73	1	8	2045	32.560	7.7	137-40
73	1	8	2330	32.603	7.7	136-40
73	1	9	220	32.331	7.6	135-40
73	1	9	520	32.522	8.2	134-40
73	1	9	830	32.585	8.1	133-40
73	1	9	1145	32.589	8.2	132-40
73	1	9	1330	32.533	7.7	131-40
73	1	9	1730	32.604	8.0	130-40
73	1	9	2200	32.497	8.2	129-40
73	1	10	130	32.429	8.2	128-40
73	1	10	500	32.428	8.0	127-40
73	1	10	830	32.431	8.1	126-40
73	1	10	1115	32.511	8.1	126- 0
73	1	10	1255	31.713	7.7	125-33

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SALINITY-CONDUCTIVITY FORMULAE COMPARED

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SALINITY-CONDUCTIVITY FORMULAE COMPARED

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Abstract

A number of empirical relationships between electrical conductivity of sea water and salinity are compared. At 15° C., atmospheric pressure, the calculations from the formulae are compared with the Unesco Tables and with data of Brown and Allentoft. Over a wider temperature range comparisons are made with Brown and Allentofts' data, and with Unesco Tables at atmospheric pressure, also at one thousand decibars, at two thousand decibars, and at five thousand decibars using Bradshaw and Schleichers' pressure correction equation as standard. Aimed at the user, these comparisons facilitate choice of an appropriate formulation, and allow quotation of limits of error with respect to currently available experimental data.

Introduction

Several recent reviews of the history and problems of salinity determinations are available (Cox 1963, Carritt 1963, Tsurikova and Tsurikov 1971). Experimental data relating electrical conductivity of sea water to salinity (or chlorinity) and temperature at atmospheric pressure are given by Thomas, Thompson and Utterback (1934), Reeburgh (1965), Cox, Culkin and Riley (1967), and Brown and Allentoft (1966). Pollak (1954), Weyl (1964), Park and Burt (1965), and Cox (1963) have remarked upon the quality of, and possible errors in, the data of Thomas et al. Cox et al (1967) have compared their data with those of Brown and Allentoft. The data of Cox et al (1967) form the basis to the currently standard International Oceanographic Tables (Unesco 1966). The effect of pressure on the electrical conductivity of sea water has been investigated by Hamon (1958), Horne and Frysinger (1963) and Bradshaw and Schleicher (1965).

The above constitutes the published experimental data. The range of values of temperature and salinity in each body of experimental data is shown in Table 1. The ranges of values of S, T, and P in different waters of the globe have been outlined by Leroy (1969). To use experimental data to convert values of conductivity (C), temperature (T), and pressure (P), measured in situ, to salinity (S), a functional relationship of the form $S = f(C, T, P)$ is necessary. The approximating equations in Cox et al (op. cit.) and the International Tables seem intended for use with laboratory salinometers as no pressure effects are included and the temperature ranges extend down only to 10° C. Brown and Allentofts' data covers a wide range of temperatures and salinity values, and they have developed expressions for the average relationship between salinity and the ratio of in situ conductivity to that of sea water at 35‰. Indication of temperature dependence of the relationship is given but no pressure effects are included.

Therefore, to meet specific needs, either for high accuracy over restricted ranges, or adequate accuracy over wider ranges, many workers have devised numerical fits to the relatively limited body of hard data described above.

A number of empirical functional relationships valid over various (fairly wide) ranges of S, T and P have appeared (and are still appearing) in the literature. This brief, and still incomplete, note extends a recent

comparison by Greenberg (1972) of formulae in use in Canada, to include several others of the same type.

Empirical Relationships

Perkin-Walker (1971)

Designed for use in the Canadian Arctic Archipelago. Claimed accuracy of $0.01^\circ/\text{‰}$ over $0 \leq T \leq 20^\circ \text{ C.}$, $5 \leq S \leq 40^\circ/\text{‰}$, $0 \leq P \leq 1700 \text{ db.}$ Based on Brown and Allentoft data with linear fit to Bradshaw and Schleicher data. $C(35,0,0) = 29.039 \text{ mmhos cm}^{-1}$ in International units [$C(35,15,0) = 42.923 \text{ mmhos cm}^{-1}$].

Rohde Quoted By Keyte (1970)

Fit over $-3.5 \leq T \leq 30^\circ \text{ C.}$, $30 \leq S \leq 41^\circ/\text{‰}$, $0 \leq P \leq 11000 \text{ db.}$ Based on fits to data of Thomas et al, and Bradshaw and Schleicher. Precise fit would indicate $C(35,15,0) = 42.899 \text{ mmhos cm}^{-1}$.

Ribe-Howe (1967)

Claimed accuracy of $\pm 0.01^\circ/\text{‰}$ for $0 \leq T \leq 25^\circ \text{ C.}$, $30 \leq S \leq 40^\circ/\text{‰}$, $0 \leq P \leq 7000 \text{ db.}$ Based on data of Cox et al, Brown and Allentoft and Bradshaw and Schleicher. Their note indicates a value of $C(35,15,0) = 42.918 \text{ mmhos cm}^{-1}$ in International units was used in their formulation but precise fit indicates $C(35,15,0) = 42.917 \text{ mmhos cm}^{-1}$.

Bennett (Quoted By Greenberg 1972)

Claimed accuracy $\pm 0.01^\circ/\text{‰}$ for $T = 0^\circ \text{ C.}$, $26 \leq S \leq 40^\circ/\text{‰}$, $P = 0 \text{ db.}$
 $T = 30^\circ \text{ C.}$, $27 \leq S \leq 40^\circ/\text{‰}$, $P = 0 \text{ db.}$; $T = 0^\circ \text{ C.}$, $33 \leq S \leq 37^\circ/\text{‰}$, $P = 1000 \text{ db.}$
 $T = 10^\circ \text{ C.}$, $31 \leq S \leq 38^\circ/\text{‰}$, $P = 1000 \text{ db.}$; $T = 20^\circ \text{ C.}$, $30 \leq S \leq 39^\circ/\text{‰}$, $P = 1000 \text{ db.}$
 $T = 30^\circ \text{ C.}$, $30 \leq S \leq 40^\circ/\text{‰}$, $P = 1000 \text{ db.}$ Precise fit gives $C(35,15,0) = 42.929 \text{ mmhos cm}^{-1}$.

ZDLP (Zaburdaev et al, 1969)

Fit over $0 \leq T \leq 25^\circ \text{ C.}$, $31 \leq S \leq 39^\circ/\text{‰}$, $0 \leq P \leq 1000 \text{ db.}$ Based on Unesco Tables and Bradshaw and Schleicher. $C(35,15,0) = 42.896 \text{ mmhos cm}^{-1}$.

Federov (1971)

Fit over $0 \leq T \leq 30^\circ \text{ C.}$, $33 \leq S \leq 37^\circ/\text{‰}$, $0 \leq P \leq 2000 \text{ db}$ with error limit $0.02^\circ/\text{‰}$. Based on Unesco Tables, fits to pressure effects of Bradshaw and Schleicher, and temperature effects of Brown and Allentoft. No absolute value of conductivity used.

Accerboni-Mosetti (1967)

Fit over range $0 \leq T \leq 30^\circ \text{ C.}$, $0 \leq S \leq 40^\circ/\text{‰}$, $P = 0 \text{ db.}$ Based on data of Cox et al, and Brown and Allentoft. No pressure dependence. Indicated value $C(35,15,0) = 42.905 \text{ mmhos cm}^{-1}$ but precise fit gives $C(35,15,0) = 42.902 \text{ mmhos cm}^{-1}$.

Pritchard - (Personal Communication From Dr. T. Dauphinee, National Research Council, Ottawa).

No accuracy or range of values available. No pressure dependence. Precise fit gives $C(35,15,0) = 42.913 \text{ mmhos cm}^{-1}$.

University of Washington (Daniel and Collias 1971)

Average departure $\pm 0.013\%$ for $0 \leq T \leq 30^\circ \text{ C.}$, $10 \leq S \leq 35\text{‰}$, $P = 0 \text{ db.}$ Based on data of Thomas et al. No pressure dependence. Precise fit indicates $C(35,15,0) = 42.698 \text{ mmhos cm}^{-1}$.

Brown (Quoted by Jaeger 1973)

Fit over $0 \leq T \leq 30^\circ \text{ C.}$, $5 \leq S \leq 60\text{‰}$, $P = 0 \text{ db.}$ Fit to Brown and Allentoft data. No pressure dependence. No absolute value of $C(35,15,0)$ used.

Test of Formulations

The formulae were fits tested against the International Oceanographic Tables at $T = 15^\circ \text{ C.}$, $P = 0 \text{ db.}$ Values of $R_{15} = C(S,15,0)/C(35,15,0)$ taken from the tables were multiplied by the values of $C(35,15,0)$ obtained by a forced fit at 35‰ , 15° C. , 0 db. Resulting values of $C(S,15,0)$ were then entered in the formulae to give the comparison shown in Table 2.

Exactly the same procedure was followed, using values of R_{15} from Brown and Allentofts' Table 21. This comparison is shown in Table 3.

Table 2 is an indicator of the range of validity of the different formulae. The formula from the Unesco Tables is used unchanged by routines "ZDLP" and "Federov", so agreement is exact. Values given by the Perkin-Walker and Brown formulations, based on Brown and Allentoft experimental data, include the differences between their data and values from the Unesco Tables. In Table 3 the values from "ZDLP" and "Federov" which agree with the Unesco Tables indicate the differences between the contents of the Unesco Tables and Brown and Allentofts' data. The method of comparison, using the forced fit value of $C(35,15,0)$ may not be the optimum for every formula. However, for all, the fit is quite good at common salinities (better than 0.01% for $30 \leq S \leq 40\text{‰}$). Only at salinities which depart further from 35‰ are major differences between formulae evident.

For a coarse test of the fit of the formulae to Brown and Allentofts' data and Unesco Tables, comparisons at a wide range of temperatures and at both atmospheric and elevated pressures were made in the following manner. From Brown and Allentofts' tables of experimental data values of $R_T = C(S,T,0)/C(35,T,0)$ were found directly. Values of salinity corresponding to values in Brown and Allentofts' Table 23 were found by interpolation in their Table 21. Values at $T = -1, -2^\circ \text{ C.}$ were found by extrapolation using a Gaussian routine supplied with the HP 9100 desk calculator. These were then multiplied by the factor $C(35,T,0)/C(35,15,0)$ from Brown and Allentofts' Table 24 to give $R_{15} = C(S,T,0)/C(35,15,0)$. These values of R_{15} were multiplied by the precise fit values of $C(35,15,0)$ appropriate for each formulation. The resulting values of $C(S,T,0)$ were then fed back into each formulation. Tables of differences between experimental data and the salinities calculated from the formulae

are shown in parts (a) of Tables 4 to 13. For parts (b), (c), (d) of these tables the input data has been adjusted to pressures of 1000 db, 2000 db, and 5000 db, respectively, using equation (1) of Bradshaw and Schleicher (op. cit.). Tables 14 to 23 are similar comparisons with the Unesco Tables. In this case the ratio $C(S,T,0)/C(35,T,0)$ from the tables was multiplied by the factor $C(35,T,0)/C(35,15,0)$ from Brown and Allentofts' Table 24, then the value for $C(35,15,0)$ appropriate for each formulation was used.

During examination of these tables, a number of points must be kept in mind. The values at temperatures colder than 0°C . are fictitious at lower salinities and include small effects due to the method of extrapolation. The Perkin-Walker and Brown are the only fits directly to Brown and Allentoft data. All others are, as shown in Figures 2 and 3, more nearly fits to values from the Unesco Tables. The main differences between these two sets of values are those shown in Tables 2 and 3. There are other smaller differences which may be seen in Table 24, in which the Unesco Table values of $R_T = C(S,T,0)/C(35,T,0)$ normalized at 15°C . are divided by values of R_T from Brown and Allentofts' data, also normalized at 15°C . The departure of these ratios from a value of 1.00000 is equivalent to a maximum salinity difference of about 0.007‰ for $20 \leq S \leq 25\text{‰}$, $T = 10^{\circ}\text{C}$.

It is to be noted that the Perkin-Walker and Federov formulations include a pressure correction linear in pressure while Bradshaw and Schleichers' equation (1) (op. cit.) is of third degree in pressure. The effects may be seen in parts (b), (c) and (d) of the tables. At 1000 db, roughly midway between Bradshaw and Schleichers' data points, the difference between linear and third degree fits is near maximum and amounts to an effect on salinity of about 0.015‰ . At 2000 db the linear fits are near their higher pressure data point, but at 5000 db the linear fits depart widely from the third degree fit. Recent work by Ettle (1969) perhaps suggests that the pressure effect from atmospheric up to 2000 db may be complicated. There is very great scatter in his data. This is however an area which might benefit from further investigation. Although the tables cover a wide range of salinity values, it may be noted from Leroy (op. cit.) that at high pressures only corrections at salinities near 35‰ are of general practical importance.

As well as comparing the formulae with Unesco Tables and data of Brown and Allentoft, comparison was made using arbitrary values of $C(S,T,P)$ over a range of salinities, temperatures, and pressures. An example is given in Table 25. The results here highlight the dangers of using any of these formulae with instruments calibrated with an inappropriate value of $C(35,15,0)$.

Dr. T.M. Dauphinee of Canada National Research Council, Ottawa, has found (personal communication) that corrections of size to 0.02‰ should be added to Ribe and Howes' equations below 2°C . As suggested by Perkin and Walker (1971), this type of correction should be added to all formulations which extrapolate to temperatures below 0°C . in the same manner as Ribe and Howes' equation. It is not included in Perkin-Walker in this note.

Another source of error to the unwary was suggested by Dr. C.S. Mason of the Bedford Institute (personal communication). All the data mentioned herein was obtained before the adoption of the International Practical Temperature Scale of 1968 (Comite International des Poids et Mesures 1969). The new

scale, while coinciding with the old scale at 0° C. is colder by 0.009° C. at 30° C. Conversion to IPTS-68 can be achieved by adjusting, in an appropriate manner, IPTS-48 temperatures and other values depending upon temperature.

The various formulae in double precision IBM FORTRAN IV are listed in the Appendix. From these listings, or equations from the original papers, estimates can be made of computation times (which differ widely) and compatibility with the devices to be used for data processing. These considerations and the error maps in the tables should allow optimum choice of processing routines.

Conclusions

The comparisons in this note indicate that results of all formulae are adequate near salinities of 35‰ and temperatures of 15° C. Under extreme conditions of salinity and temperature, differences between formulae can be large and should be taken into account in precise work. This note should enable users to choose a procedure which will fit their immediate requirements.

However, for maximum general usefulness, a standardized procedure should be quickly agreed upon by the oceanographic community. This procedure must allow computations, within stated accuracy, over values of S, T, and P found both in bench and in situ salinometry. Additional experimental work may be needed, in the area of pressure effects, and at temperatures below 0° C.

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List of Tables

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4. Brown-Allentoft salinity values minus values by Perkin-Walker. $C(35,15,0) = 42.923\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
5. Brown-Allentoft salinity values minus values by Rohde. $C(35,15,0) = 42.899\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
6. Brown-Allentoft salinity values minus values by Ribe-Howe. $C(35,15,0) = 42.917\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
7. Brown-Allentoft salinity values minus values by Bennett. $C(35,15,0) = 42.929\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
8. Brown-Allentoft salinity values minus values by ZDLP. $C(35,15,0) = 42.896\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
9. Brown-Allentoft salinity values minus values by Federov. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
10. Brown-Allentoft salinity values minus values by Mosetti-Accerboni. $C(35,15,0) = 42.902\text{ mmhos cm}^{-1}$. 0 db.
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12. Brown-Allentoft salinity values minus values by Washington. $C(35,15,0) = 42.698\text{ mmhos cm}^{-1}$. 0 db.
13. Brown-Allentoft average experimental salinity values minus values by Brown. Pressure 0 db.
14. International Oceanographic Tables salinity values minus values by Perkin-Walker. $C(35,15,0) = 42.923\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
15. International Oceanographic Tables salinity values minus values by Rohde. $C(35,15,0) = 42.899\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
16. International Oceanographic Tables salinity values minus values by Ribe-Howe. $C(35,15,0) = 42.917\text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.

17. International Oceanographic Tables salinity values minus values by Bennett. $C(35,15,0) = 42.929 \text{ mmhos cm}^{-1}$. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
18. International Oceanographic Tables salinity values minus values by ZDLP. $C(35,15,0) = 42.896 \text{ mmhos cm}^{-1}$. 0 db.
19. International Oceanographic Tables salinity values minus values by Federov. (a) 0 db (b) 1000 db (c) 2000 db (d) 5000 db.
20. International Oceanographic Tables salinity values minus values by Mosetti-Accerboni. $C(35,15,0) = 42.902 \text{ mmhos cm}^{-1}$. 0 db.
21. International Oceanographic Tables salinity values minus values by Pritchard. $C(35,15,0) = 42.912 \text{ mmhos cm}^{-1}$. 0 db.
22. International Oceanographic Tables salinity values minus values by Washington. $C(35,15,0) = 42.698 \text{ mmhos cm}^{-1}$. 0 db.
23. International Oceanographic Tables salinity values minus values by Brown. Pressure 0 db.
24. Values of $R_T = C(S,T,0)/C(35,T,0)$ from Unesco Tables normalized at 15° C. , divided by values of R_T (also normalized at 15° C.) from Brown and Allentofts' data.
25. Salinities computed from formulae using input $C = 42.80 \text{ mmhos cm}^{-1}$, $T = 15^\circ \text{ C.}$, $P = 0 \text{ db.}$

TABLE 1
RANGE OF VALUES IN DATA

Data

Thomas et al	$0^{\circ} \leq T \leq 20^{\circ} \text{ C.}; 10 \leq S \leq 35^{\circ}/_{\text{oo}};$ $T = 25^{\circ}; 3 \leq S \leq 39^{\circ}/_{\text{oo}};$	$P = 0$ $P = 0$
Reeburgh	$-1 \leq T \leq 35^{\circ} ; 28 \leq S \leq 40^{\circ}/_{\text{oo}};$	$P = 0$
Cox et al	$T = 15^{\circ}; 25 \leq S \leq 41^{\circ}/_{\text{oo}};$ $14 \leq T \leq 29^{\circ}; 4 \leq S \leq 42^{\circ}/_{\text{oo}};$	$P = 0$ $P = 0$
Brown and Allentoft	$0 \leq T \leq 30^{\circ}; 2 \leq S \leq 40^{\circ}/_{\text{oo}};$ $T = 15^{\circ}; 0 \leq S \leq 60^{\circ}/_{\text{oo}};$ $0 \leq T \leq 35^{\circ}; S = 35^{\circ}/_{\text{oo}};$	$P = 0$ $P = 0$ $P = 0$
Dauphinee	$-2 \leq T \leq 0^{\circ}; 30 \leq S \leq 35^{\circ}/_{\text{oo}};$	$P = 0$
Bradshaw and Schleicher	$T = 0, 5, 10, 15, 20, 25^{\circ}$ $S = 31, 35, 39^{\circ}/_{\text{oo}}$ $P = 0 - 10,338 \text{ db}$	

TABLE 2

R15	UNESCO SALINITY	PERKIN WALKER	ROHDE	RIBE HOWE	BENNETT	ZDLP	FEDEROV ACERBONI	MOSETTI	PRITCHARD	WASH.	BROWN
0.0	-0.090	0.144	1.543	0.594	-0.090	-0.000	-0.000	-0.090	*****	0.415	0.130
0.05	1.356	0.062	1.244	0.513	-0.156	-0.000	-0.000	0.001	-0.007	0.262	0.065
0.10	2.858	0.010	0.995	0.371	-0.194	-0.000	-0.000	0.012	-0.007	0.147	0.020
0.15	4.410	-0.021	0.791	0.262	-0.211	0.000	0.000	0.008	-0.020	0.063	-0.010
0.20	6.006	-0.036	0.624	0.179	-0.211	-0.000	-0.000	0.002	-0.033	0.004	-0.028
0.25	7.640	-0.040	0.488	0.119	-0.200	0.000	0.000	-0.002	-0.042	-0.035	-0.037
0.30	9.309	-0.040	0.379	0.075	-0.181	0.000	0.000	-0.005	-0.048	-0.057	-0.040
0.35	11.008	-0.037	0.291	0.045	-0.157	-0.000	-0.000	-0.004	-0.049	-0.069	-0.039
0.40	12.735	-0.036	0.222	0.025	-0.131	-0.000	-0.000	-0.003	-0.048	-0.071	-0.035
0.45	14.485	-0.034	0.167	0.012	-0.105	-0.000	-0.000	-0.000	-0.045	-0.067	-0.030
0.50	16.259	-0.031	0.125	0.005	-0.081	0.000	0.000	0.002	-0.041	-0.060	-0.025
0.55	18.053	-0.026	0.092	0.001	-0.059	-0.000	-0.000	0.005	-0.037	-0.051	-0.020
0.60	19.866	-0.021	0.067	-0.001	-0.040	0.000	0.000	0.006	-0.032	-0.041	-0.016
0.65	21.697	-0.016	0.048	-0.001	-0.025	0.000	0.000	0.007	-0.028	-0.031	-0.012
0.70	23.546	-0.012	0.033	-0.001	-0.014	0.000	0.000	0.007	-0.024	-0.022	-0.009
0.75	25.413	-0.008	0.023	-0.001	-0.006	0.000	0.000	0.006	-0.021	-0.014	-0.007
0.80	27.296	-0.006	0.015	-0.001	-0.002	-0.000	-0.000	0.004	-0.018	-0.009	-0.006
0.85	29.196	-0.004	0.009	-0.000	0.001	-0.000	-0.000	0.002	-0.014	-0.004	-0.005
0.90	31.114	-0.002	0.005	-0.000	0.001	0.000	0.000	0.001	-0.010	-0.001	-0.004
0.95	33.048	-0.001	0.002	-0.000	0.001	0.000	0.000	-0.000	-0.006	0.000	-0.002
1.00	35.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000
1.05	36.969	0.002	-0.002	0.000	-0.000	-0.000	-0.000	0.001	0.007	-0.001	0.003
1.10	38.955	0.005	-0.005	0.001	0.000	0.000	0.000	0.004	0.016	-0.004	0.006
1.15	40.959	0.011	-0.009	0.002	0.003	0.000	0.000	0.008	0.026	-0.008	0.009
1.20	42.979	0.019	-0.017	0.002	0.006	-0.000	-0.000	0.013	0.037	-0.014	0.012
1.25	45.015	0.031	-0.027	0.001	0.011	0.000	0.000	0.019	0.049	-0.022	0.014
1.30	47.066	0.046	-0.043	-0.001	0.018	0.000	0.000	0.025	0.060	-0.034	0.014
1.35	49.131	0.064	-0.066	-0.007	0.026	-0.000	-0.000	0.029	0.070	-0.051	0.010
1.40	51.209	0.083	-0.099	-0.018	0.033	-0.000	-0.000	0.030	0.077	-0.074	0.000
1.45	53.297	0.100	-0.143	-0.035	0.039	0.000	0.000	0.026	0.080	-0.105	-0.017

UNESCO TABLE SALINITY VALUES IN PARTS PER THOUSAND MINUS THOSE CALCULATED
 FROM FORMULAE USING A FORCED FIT AT C(35,15.0)
 TEMPERATURE = 15.0 (DEGREES CELSIUS)
 PRESSURE = 0.0 (DECIBARS)

TABLE 3

R15	B. - A. SALINITY	PERKIN WALKER	ROHDE	RIBE HOWE	BENNETT	ZOLP	FEDEROV ACERBONI	MOSETTI	PRITCHARD	WASH.	BROWN
0.0	0.0	0.234	1.633	0.784	0.0	0.090	0.090	0.0	*****	0.505	0.220
0.05	1.383	0.090	1.271	0.540	-0.128	0.027	0.027	0.029	0.021	0.299	0.092
0.10	2.878	0.030	1.016	0.392	-0.174	0.021	0.021	0.032	0.013	0.167	0.040
0.15	4.436	0.005	0.817	0.288	-0.185	0.026	0.026	0.034	0.006	0.089	0.016
0.20	6.038	-0.003	0.656	0.212	-0.179	0.033	0.033	0.035	-0.000	0.036	0.004
0.25	7.678	-0.003	0.525	0.156	-0.162	0.037	0.037	0.035	-0.005	0.003	-0.000
0.30	9.348	-0.001	0.417	0.114	-0.142	0.039	0.039	0.034	-0.009	-0.019	-0.002
0.35	11.046	0.001	0.329	0.083	-0.119	0.038	0.038	0.033	-0.012	-0.031	-0.002
0.40	12.769	-0.001	0.257	0.060	-0.096	0.035	0.035	0.032	-0.014	-0.036	-0.001
0.45	14.517	-0.003	0.198	0.043	-0.074	0.031	0.031	0.031	-0.014	-0.036	0.001
0.50	16.285	-0.004	0.151	0.031	-0.054	0.027	0.027	0.029	-0.015	-0.034	0.001
0.55	18.075	-0.004	0.114	0.023	-0.037	0.022	0.022	0.027	-0.015	-0.029	0.002
0.60	19.885	-0.002	0.086	0.018	-0.021	0.019	0.019	0.025	-0.013	-0.022	0.003
0.65	21.712	-0.001	0.063	0.014	-0.010	0.015	0.015	0.022	-0.013	-0.016	0.003
0.70	23.556	-0.002	0.043	0.009	-0.004	0.010	0.010	0.017	-0.014	-0.012	0.001
0.75	25.421	-0.000	0.031	0.007	0.002	0.008	0.008	0.014	-0.013	-0.006	0.001
0.80	27.303	0.001	0.021	0.006	0.005	0.007	0.007	0.011	-0.011	-0.002	0.001
0.85	29.202	0.001	0.014	0.005	0.006	0.005	0.005	0.008	-0.009	0.001	0.000
0.90	31.118	0.001	0.009	0.003	0.005	0.004	0.004	0.005	-0.007	0.002	0.000
0.95	33.050	0.001	0.004	0.002	0.003	0.002	0.002	0.002	-0.004	0.002	0.000
1.00	35.000	0.000	0.000	0.000	0.000	0.000	-0.000	0.000	0.000	0.000	0.000
1.05	36.967	-0.001	-0.005	-0.002	-0.003	-0.003	-0.003	-0.001	0.005	-0.004	0.000
1.10	38.950	-0.000	-0.011	-0.004	-0.005	-0.005	-0.005	-0.001	0.010	-0.009	0.000
1.15	40.950	0.003	-0.018	-0.006	-0.006	-0.008	-0.008	-0.000	0.018	-0.016	0.001
1.20	42.967	0.008	-0.028	-0.009	-0.005	-0.011	-0.011	0.002	0.026	-0.025	0.001
1.25	45.003	0.019	-0.039	-0.011	-0.001	-0.012	-0.012	0.007	0.037	-0.034	0.002
1.30	47.054	0.035	-0.055	-0.013	0.006	-0.012	-0.012	0.013	0.048	-0.046	0.002
1.35	49.123	0.056	-0.074	-0.015	0.017	-0.008	-0.008	0.021	0.062	-0.059	0.002
1.40	51.209	0.083	-0.098	-0.017	0.034	0.000	0.000	0.031	0.078	-0.073	0.001
1.45	53.313	0.116	-0.127	-0.018	0.056	0.017	0.017	0.043	0.096	-0.088	-0.000

BROWN AND ALLEN TOFT AVERAGE EXPERIMENTAL SALINITY IN PARTS PER THOUSAND
 MINUS THOSE FROM FORMULAE USING A FORCED FIT AT C(35.15.0)
 TEMPERATURE = 15.0 (DEGREES CELSIUS)
 PRESSURE = 0.0 (DECIBARS)

TABLE 4(a)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	0.055	-0.003	-0.020	-0.023	-0.018	-0.009	0.000	0.009	0.028
25.	0.060	0.004	-0.008	-0.012	-0.009	-0.006	-0.004	-0.002	0.010
20.	0.061	0.008	-0.002	-0.004	-0.002	0.000	-0.000	0.000	0.007
15.	0.061	0.009	-0.000	-0.004	-0.002	-0.000	0.001	0.000	0.001
10.	0.059	0.007	-0.002	-0.003	-0.003	0.001	0.003	0.002	-0.001
5.	0.056	0.006	-0.002	-0.003	-0.003	-0.001	0.004	0.002	-0.002
0.	0.053	0.005	0.000	-0.003	-0.003	-0.000	0.003	0.003	-0.002
-1.	0.052	0.005	0.002	-0.001	-0.001	0.003	0.005	0.006	0.001
-2.	0.052	0.005	0.004	0.000	0.000	0.005	0.007	0.009	0.004

BROWN-ALLENTOF AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 C(35,15,0) = 42.923 MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 4(b)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	0.056	-0.001	-0.017	-0.020	-0.017	-0.010	-0.002	0.004	0.022
25.	0.061	0.006	-0.006	-0.012	-0.011	-0.011	-0.011	-0.011	-0.001
20.	0.062	0.010	-0.000	-0.005	-0.005	-0.005	-0.009	-0.010	-0.005
15.	0.062	0.011	0.001	-0.004	-0.005	-0.006	-0.007	-0.010	-0.010
10.	0.060	0.009	0.000	-0.003	-0.006	-0.005	-0.006	-0.008	-0.012
5.	0.057	0.008	-0.000	-0.004	-0.007	-0.008	-0.005	-0.009	-0.013
0.	0.054	0.007	0.001	-0.006	-0.010	-0.010	-0.009	-0.010	-0.014
-1.	0.054	0.007	0.002	-0.005	-0.009	-0.008	-0.008	-0.008	-0.012
-2.	0.053	0.007	0.004	-0.004	-0.008	-0.007	-0.008	-0.006	-0.009

BROWN-ALLENTOF AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 C(35,15,0) = 42.923 MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 4(c)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE DEGREES CELSIUS									
30.	0.058	0.003	-0.009	-0.010	-0.006	0.001	0.009	0.016	0.034
25.	0.063	0.010	0.001	-0.003	-0.001	-0.001	-0.002	-0.001	0.009
20.	0.065	0.015	0.008	0.005	0.006	0.005	0.002	0.001	0.006
15.	0.065	0.016	0.011	0.007	0.007	0.007	0.006	0.004	0.005
10.	0.064	0.015	0.011	0.010	0.008	0.010	0.010	0.009	0.008
5.	0.061	0.015	0.011	0.011	0.008	0.008	0.013	0.012	0.011
0.	0.058	0.014	0.014	0.010	0.007	0.007	0.010	0.012	0.013
-1.	0.058	0.015	0.015	0.010	0.008	0.009	0.011	0.015	0.017
-2.	0.057	0.014	0.017	0.011	0.009	0.011	0.012	0.017	0.020

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 $C(35,15,0) = 42.923$ MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 4(d)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE DEGREES CELSIUS									
30.	0.070	0.027	0.041	0.060	0.079	0.100	0.120	0.138	0.168
25.	0.076	0.036	0.055	0.073	0.090	0.105	0.117	0.130	0.154
20.	0.080	0.044	0.068	0.090	0.108	0.124	0.136	0.150	0.172
15.	0.082	0.049	0.080	0.104	0.124	0.143	0.160	0.176	0.198
10.	0.083	0.054	0.090	0.120	0.142	0.166	0.187	0.207	0.231
5.	0.083	0.059	0.101	0.136	0.160	0.186	0.215	0.239	0.269
0.	0.083	0.064	0.115	0.152	0.179	0.209	0.240	0.272	0.310
-1.	0.083	0.065	0.118	0.156	0.184	0.216	0.247	0.282	0.322
-2.	0.083	0.066	0.123	0.160	0.189	0.223	0.254	0.292	0.334

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 $C(35,15,0) = 42.923$ MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 5(a)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	2.184	1.637	0.775	0.336	0.139	0.041	0.010	0.002	-0.009
25.	1.343	0.949	0.376	0.120	0.027	-0.006	-0.004	0.006	-0.001
20.	1.191	0.850	0.361	0.143	0.058	0.022	0.013	0.010	-0.004
15.	1.167	0.849	0.389	0.172	0.079	0.031	0.011	0.000	-0.015
10.	1.078	0.783	0.359	0.160	0.071	0.026	0.007	-0.000	-0.004
5.	0.936	0.673	0.303	0.138	0.066	0.033	0.024	0.023	0.032
0.	0.810	0.578	0.264	0.127	0.072	0.047	0.037	0.036	0.048
-1.	0.788	0.561	0.256	0.123	0.069	0.045	0.033	0.031	0.041
-2.	0.765	0.542	0.246	0.115	0.062	0.038	0.022	0.018	0.025

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RHODE
 $C(35,15,0) = 42.859$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 5(b)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	2.169	1.622	0.762	0.326	0.132	0.036	0.006	-0.001	-0.014
25.	1.354	0.958	0.381	0.124	0.029	-0.004	-0.003	0.004	-0.005
20.	1.215	0.871	0.376	0.154	0.066	0.027	0.015	0.010	-0.007
15.	1.193	0.872	0.406	0.185	0.088	0.037	0.014	0.001	-0.017
10.	1.101	0.804	0.375	0.171	0.079	0.031	0.010	0.000	-0.006
5.	0.959	0.694	0.319	0.148	0.073	0.035	0.024	0.021	0.029
0.	0.848	0.612	0.288	0.141	0.080	0.049	0.035	0.030	0.040
-1.	0.831	0.599	0.283	0.139	0.078	0.047	0.030	0.024	0.032
-2.	0.814	0.586	0.277	0.134	0.073	0.041	0.018	0.010	0.015

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RHODE
 $C(35,15,0) = 42.899$ MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 5(c)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
<hr/>										
TEMPERATURE										
DEGREES CELSIUS										
	30.	2.152	1.605	0.749	0.317	0.125	0.032	0.004	-0.003	-0.017
	25.	1.360	0.962	0.384	0.125	0.030	-0.004	-0.003	0.003	-0.008
	20.	1.231	0.885	0.385	0.160	0.071	0.030	0.016	0.010	-0.009
	15.	1.210	0.887	0.416	0.192	0.094	0.040	0.016	0.001	-0.018
	10.	1.114	0.815	0.383	0.178	0.084	0.034	0.011	0.001	-0.006
	5.	0.970	0.704	0.326	0.153	0.076	0.037	0.024	0.020	0.028
	0.	0.868	0.630	0.302	0.151	0.085	0.050	0.033	0.027	0.036
	-1.	0.855	0.622	0.300	0.150	0.085	0.049	0.028	0.020	0.027
	-2.	0.843	0.613	0.297	0.147	0.080	0.043	0.017	0.006	0.009

BROWN-ALLENTOLT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ROHDE
 $C(35,15,0) = 42.899$ MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 5(d)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
<hr/>										
TEMPERATURE										
DEGREES CELSIUS										
30.		2.101	1.558	0.712	0.292	0.110	0.025	0.001	-0.006	-0.024
25.		1.355	0.955	0.375	0.118	0.025	-0.006	-0.005	0.001	-0.012
20.		1.245	0.895	0.390	0.163	0.072	0.031	0.016	0.008	-0.014
15.		1.219	0.894	0.421	0.156	0.096	0.042	0.016	-0.000	-0.021
10.		1.105	0.808	0.379	0.176	0.084	0.034	0.011	0.001	-0.006
5.		0.945	0.684	0.315	0.148	0.073	0.036	0.024	0.020	0.030
0.		0.851	0.619	0.298	0.150	0.085	0.050	0.032	0.026	0.036
-1.		0.846	0.617	0.302	0.154	0.087	0.050	0.028	0.018	0.026
-2.		0.843	0.617	0.305	0.155	0.086	0.046	0.016	0.003	0.007

BROWN-ALLENTOLT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ROHDE
 $C(35,15,0) = 42.899$ MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 6(a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	0.425	0.256	0.068	0.014	0.001	-0.002	0.002	0.002	-0.002	
25.	0.448	0.277	0.085	0.025	0.009	0.002	0.000	-0.000	-0.004	
20.	0.467	0.295	0.097	0.034	0.016	0.008	0.004	0.002	-0.002	
15.	0.477	0.304	0.103	0.037	0.017	0.007	0.004	0.000	-0.006	
10.	0.467	0.296	0.098	0.036	0.016	0.010	0.006	0.001	-0.007	
5.	0.414	0.253	0.073	0.023	0.011	0.009	0.009	0.002	-0.005	
0.	0.283	0.142	0.004	-0.020	-0.013	-0.001	0.004	-0.000	-0.005	
-1.	0.242	0.108	-0.018	-0.033	-0.020	-0.003	0.003	0.001	-0.003	
-2.	0.195	0.068	-0.043	-0.049	-0.029	-0.006	0.000	0.001	-0.003	

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 $C(35,15.0) = 42.917$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 6(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	0.414	0.248	0.066	0.016	0.005	0.004	0.009	0.009	0.006	
25.	0.434	0.267	0.080	0.023	0.009	0.003	0.002	0.001	-0.002	
20.	0.452	0.283	0.091	0.031	0.014	0.007	0.003	0.001	-0.002	
15.	0.459	0.290	0.096	0.033	0.015	0.006	0.003	-0.001	-0.007	
10.	0.447	0.280	0.090	0.032	0.014	0.009	0.005	-0.001	-0.008	
5.	0.391	0.235	0.063	0.018	0.008	0.007	0.007	-0.000	-0.007	
0.	0.256	0.121	-0.007	-0.026	-0.017	-0.004	0.000	-0.004	-0.009	
-1.	0.214	0.086	-0.029	-0.039	-0.024	-0.006	-0.001	-0.003	-0.008	
-2.	0.166	0.045	-0.055	-0.056	-0.034	-0.010	-0.004	-0.004	-0.008	

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 $C(35,15.0) = 42.917$ MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 6(c)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE									
DEGREES CELSIUS									
30.	0.402	0.240	0.063	0.017	0.008	0.009	0.015	0.016	0.014
25.	0.421	0.257	0.075	0.022	0.010	0.005	0.004	0.004	0.000
20.	0.436	0.271	0.085	0.029	0.013	0.007	0.003	0.002	-0.002
15.	0.441	0.276	0.089	0.030	0.013	0.006	0.003	-0.001	-0.007
10.	0.426	0.264	0.082	0.028	0.013	0.008	0.005	-0.000	-0.008
5.	0.367	0.217	0.054	0.014	0.007	0.006	0.007	-0.000	-0.007
0.	0.227	0.099	-0.019	-0.031	-0.019	-0.005	0.000	-0.004	-0.009
-1.	0.184	0.062	-0.041	-0.045	-0.026	-0.007	-0.001	-0.004	-0.008
-2.	0.134	0.019	-0.068	-0.061	-0.036	-0.011	-0.004	-0.004	-0.008

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 C(35.15,0) = 42.917 MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 6(d)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE									
DEGREES CELSIUS									
30.	0.370	0.215	0.053	0.017	0.013	0.018	0.026	0.029	0.029
25.	0.383	0.227	0.061	0.016	0.009	0.006	0.007	0.007	0.005
20.	0.390	0.235	0.066	0.020	0.010	0.006	0.004	0.003	-0.001
15.	0.387	0.233	0.067	0.020	0.009	0.005	0.004	0.000	-0.005
10.	0.362	0.213	0.056	0.017	0.009	0.009	0.007	0.002	-0.005
5.	0.292	0.157	0.024	0.002	0.003	0.008	0.011	0.004	-0.002
0.	0.133	0.025	-0.055	-0.045	-0.021	-0.001	0.007	0.004	0.000
-1.	0.084	-0.016	-0.080	-0.059	-0.029	-0.002	0.007	0.006	0.003
-2.	0.028	-0.063	-0.109	-0.077	-0.038	-0.005	0.006	0.007	0.005

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 C(35.15,0) = 42.917 MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 7(a)

		SALINITIES (0/00)								
		1.927	4.163	9.658	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES	CELSIUS									
	30.	-0.166	-0.204	-0.161	-0.084	-0.036	-0.009	0.003	0.002	-0.004
	25.	-0.158	-0.192	-0.145	-0.072	-0.027	-0.006	0.000	-0.001	-0.002
	20.	-0.153	-0.185	-0.136	-0.063	-0.019	0.001	0.004	0.002	0.000
	15.	-0.152	-0.184	-0.135	-0.063	-0.019	0.002	0.006	0.000	-0.006
	10.	-0.153	-0.187	-0.141	-0.065	-0.020	0.004	0.008	0.001	-0.009
	5.	-0.156	-0.193	-0.150	-0.072	-0.024	0.003	0.011	0.002	-0.008
	0.	-0.162	-0.203	-0.165	-0.089	-0.037	-0.004	0.005	0.000	-0.006
	-1.	-0.163	-0.205	-0.168	-0.093	-0.039	-0.004	0.005	0.001	-0.003
	-2.	-0.165	-0.208	-0.171	-0.097	-0.043	-0.005	0.003	0.002	-0.001

BROWN-ALLENTOF AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 C(35,15.0) = 42.929 MILLIMOS
 PRESSURE IS 0.0 DECIBARS

TABLE 7(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE	DEGREES CELSIUS									
	30.	-0.168	-0.208	-0.168	-0.092	-0.043	-0.014	0.002	0.007	0.009
	25.	-0.161	-0.197	-0.155	-0.084	-0.040	-0.016	-0.006	0.000	0.008
	20.	-0.157	-0.191	-0.149	-0.079	-0.035	-0.013	-0.004	0.001	0.011
	15.	-0.156	-0.192	-0.151	-0.082	-0.038	-0.014	-0.004	-0.000	0.007
	10.	-0.158	-0.196	-0.159	-0.088	-0.043	-0.015	-0.003	0.001	0.008
	5.	-0.162	-0.205	-0.173	-0.100	-0.052	-0.021	-0.003	0.002	0.012
	0.	-0.169	-0.218	-0.193	-0.124	-0.072	-0.033	-0.012	-0.001	0.018
	-1.	-0.171	-0.221	-0.198	-0.129	-0.076	-0.035	-0.014	-0.000	0.022
	-2.	-0.173	-0.224	-0.202	-0.135	-0.081	-0.037	-0.017	0.000	0.024

BROWN-ALLENTOF AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 C(35,15.0) = 42.929 MILLIMOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 7(c)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.		-0.170	-0.211	-0.175	-0.100	-0.051	-0.019	0.001	0.010	0.020
25.		-0.163	-0.202	-0.165	-0.096	-0.052	-0.026	-0.012	-0.000	0.016
20.		-0.160	-0.198	-0.161	-0.094	-0.050	-0.025	-0.012	-0.000	0.020
15.		-0.160	-0.199	-0.165	-0.099	-0.056	-0.029	-0.013	-0.001	0.019
10.		-0.162	-0.205	-0.176	-0.109	-0.064	-0.032	-0.014	0.001	0.022
5.		-0.168	-0.215	-0.194	-0.126	-0.078	-0.042	-0.016	0.001	0.030
0.		-0.176	-0.231	-0.219	-0.155	-0.103	-0.059	-0.028	-0.002	0.040
-1.		-0.178	-0.234	-0.224	-0.162	-0.108	-0.062	-0.030	-0.001	0.044
-2.		-0.180	-0.239	-0.230	-0.169	-0.115	-0.066	-0.034	-0.000	0.048

BROWN-ALLENTOFF AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 $C(35.15,0) = 42.929$ MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 7(d)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES	CELSIUS									
30.		-0.175	-0.222	-0.195	-0.125	-0.075	-0.039	-0.011	0.011	0.039
25.		-0.170	-0.216	-0.191	-0.129	-0.085	-0.055	-0.032	-0.006	0.031
20.		-0.168	-0.214	-0.193	-0.133	-0.091	-0.061	-0.037	-0.007	0.037
15.		-0.169	-0.218	-0.202	-0.146	-0.103	-0.070	-0.040	-0.007	0.043
10.		-0.174	-0.228	-0.220	-0.163	-0.119	-0.079	-0.043	-0.004	0.055
5.		-0.182	-0.243	-0.246	-0.191	-0.143	-0.096	-0.050	-0.001	0.073
0.		-0.193	-0.263	-0.281	-0.232	-0.179	-0.122	-0.065	-0.001	0.096
-1.		-0.195	-0.268	-0.288	-0.241	-0.186	-0.126	-0.068	0.001	0.104
-2.		-0.198	-0.273	-0.296	-0.250	-0.195	-0.131	-0.071	0.003	0.111

BROWN-ALLENTOFF AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 $C(35.15,0) = 42.929$ MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 8(a)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	0.020	0.027	0.040	0.029	0.014	0.003	0.002	-0.001	-0.008
25.	0.019	0.024	0.035	0.022	0.006	-0.007	-0.013	-0.016	-0.023
20.	0.020	0.025	0.036	0.025	0.012	0.001	-0.005	-0.008	-0.014
15.	0.021	0.025	0.039	0.029	0.018	0.008	0.004	0.000	-0.007
10.	0.023	0.028	0.043	0.037	0.026	0.019	0.013	0.007	-0.002
5.	0.025	0.033	0.052	0.051	0.042	0.033	0.028	0.017	0.010
0.	0.030	0.043	0.075	0.079	0.075	0.071	0.065	0.057	0.057
-1.	0.032	0.046	0.082	0.089	0.088	0.087	0.081	0.076	0.079
-2.	0.034	0.050	0.092	0.101	0.104	0.106	0.100	0.098	0.104

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ZDLP
 C(35,15.0) = 42.896 MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 8(b)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	0.020	0.027	0.040	0.029	0.014	0.003	0.002	-0.001	-0.008
25.	0.019	0.024	0.035	0.022	0.006	-0.007	-0.013	-0.016	-0.023
20.	0.020	0.025	0.036	0.025	0.012	0.001	-0.005	-0.008	-0.014
15.	0.021	0.025	0.039	0.029	0.018	0.008	0.004	0.000	-0.007
10.	0.023	0.028	0.043	0.037	0.026	0.019	0.013	0.007	-0.002
5.	0.025	0.033	0.052	0.051	0.042	0.033	0.028	0.017	0.010
0.	0.030	0.043	0.075	0.079	0.076	0.072	0.065	0.057	0.057
-1.	0.032	0.046	0.082	0.089	0.089	0.088	0.081	0.076	0.079
-2.	0.034	0.050	0.092	0.101	0.104	0.106	0.101	0.098	0.105

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ZDLP
 C(35,15.0) = 42.896 MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 8(c)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE DEGREES CELSIUS									
30.	0.020	0.027	0.040	0.029	0.014	0.003	0.002	-0.001	-0.008
25.	0.019	0.024	0.035	0.022	0.006	-0.007	-0.013	-0.016	-0.023
20.	0.020	0.025	0.036	0.025	0.012	0.001	-0.005	-0.008	-0.014
15.	0.021	0.025	0.039	0.029	0.018	0.008	0.004	0.000	-0.007
10.	0.023	0.028	0.043	0.038	0.026	0.019	0.013	0.007	-0.002
5.	0.025	0.033	0.052	0.051	0.042	0.033	0.028	0.017	0.010
0.	0.030	0.043	0.075	0.079	0.076	0.072	0.065	0.057	0.057
-1.	0.032	0.046	0.083	0.089	0.089	0.088	0.082	0.076	0.079
-2.	0.034	0.050	0.092	0.102	0.104	0.107	0.101	0.099	0.105

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ZDLP
 $C(35,15,0) = 42.896$ MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 8(d)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE DEGREES CELSIUS									
30.	0.020	0.027	0.040	0.029	0.014	0.003	0.002	-0.001	-0.008
25.	0.019	0.024	0.035	0.022	0.006	-0.007	-0.013	-0.016	-0.023
20.	0.020	0.025	0.036	0.025	0.012	0.001	-0.005	-0.008	-0.014
15.	0.021	0.025	0.039	0.029	0.018	0.008	0.005	0.000	-0.007
10.	0.023	0.028	0.043	0.038	0.027	0.019	0.014	0.007	-0.002
5.	0.025	0.033	0.052	0.051	0.042	0.033	0.028	0.017	0.010
0.	0.030	0.043	0.075	0.079	0.076	0.072	0.066	0.058	0.058
-1.	0.032	0.047	0.083	0.090	0.089	0.088	0.082	0.077	0.080
-2.	0.034	0.050	0.092	0.102	0.105	0.107	0.102	0.100	0.107

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ZDLP
 $C(35,15,0) = 42.896$ MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 9(a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE	DEGREES CELSIUS									
30.		0.022	0.031	0.051	0.046	0.036	0.031	0.035	0.038	0.038
25.		0.020	0.025	0.039	0.028	0.015	0.004	0.000	-0.001	-0.006
20.		0.020	0.025	0.036	0.026	0.013	0.002	-0.004	-0.006	-0.012
15.		0.021	0.025	0.039	0.029	0.018	0.008	0.004	-0.000	-0.007
10.		0.023	0.028	0.043	0.038	0.028	0.020	0.015	0.009	0.001
5.		0.024	0.031	0.047	0.043	0.031	0.020	0.012	-0.001	-0.012
0.		0.024	0.030	0.042	0.028	0.008	-0.013	-0.036	-0.061	-0.080
-1.		0.024	0.029	0.040	0.022	-0.000	-0.024	-0.052	-0.080	-0.101
-2.		0.023	0.027	0.037	0.014	-0.012	-0.038	-0.073	-0.104	-0.128

BROWN-ALLENTOLT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 $C(35, 15, 0) = 42.896$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 9(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE										
DEGREES	CELSIUS									
30.		0.020	0.027	0.043	0.037	0.028	0.025	0.033	0.042	0.049
25.		0.017	0.019	0.027	0.012	-0.002	-0.012	-0.012	-0.007	-0.004
20.		0.016	0.017	0.021	0.006	-0.009	-0.018	-0.020	-0.016	-0.012
15.		0.016	0.016	0.021	0.006	-0.007	-0.014	-0.013	-0.009	-0.005
10.		0.018	0.017	0.022	0.011	-0.001	-0.005	-0.004	0.000	0.007
5.		0.018	0.018	0.021	0.010	-0.004	-0.012	-0.012	-0.013	-0.005
0.		0.016	0.013	0.008	-0.016	-0.038	-0.056	-0.071	-0.082	-0.078
-1.		0.015	0.011	0.004	-0.025	-0.050	-0.071	-0.090	-0.103	-0.102
-2.		0.014	0.008	-0.002	-0.036	-0.065	-0.089	-0.114	-0.130	-0.132

BROWN-ALLENTOLT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 $C(35, 15, 0) = 42.896$ MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 9(c)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
<hr/>										
TEMPERATURE										
DEGREES CELSIUS										
30.	0.019	0.025	0.041	0.036	0.030	0.031	0.046	0.062	0.080	
25.	0.015	0.016	0.021	0.006	-0.006	-0.012	-0.007	0.006	0.019	
20.	0.014	0.012	0.012	-0.003	-0.016	-0.021	-0.016	-0.004	0.013	
15.	0.014	0.011	0.011	-0.005	-0.015	-0.017	-0.008	0.007	0.026	
10.	0.014	0.011	0.010	-0.001	-0.010	-0.008	0.003	0.021	0.046	
5.	0.014	0.010	0.006	-0.006	-0.017	-0.017	-0.005	0.010	0.040	
0.	0.010	0.002	-0.012	-0.039	-0.058	-0.068	-0.069	-0.062	-0.033	
-1.	0.009	-0.001	-0.018	-0.050	-0.072	-0.084	-0.090	-0.085	-0.057	
-2.	0.008	-0.004	-0.025	-0.063	-0.089	-0.105	-0.117	-0.114	-0.088	

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 C(35.15.0) = 42.856 MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 9(d)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
<hr/>										
TEMPERATURE										
DEGREES CELSIUS										
30.	0.022	0.032	0.062	0.076	0.091	0.119	0.163	0.214	0.273	
25.	0.017	0.020	0.036	0.038	0.047	0.067	0.104	0.152	0.210	
20.	0.015	0.015	0.026	0.029	0.039	0.063	0.103	0.157	0.224	
15.	0.014	0.014	0.026	0.032	0.048	0.080	0.131	0.193	0.273	
10.	0.015	0.014	0.027	0.040	0.062	0.105	0.165	0.239	0.336	
5.	0.014	0.012	0.023	0.038	0.063	0.110	0.178	0.259	0.373	
0.	0.009	0.001	0.000	0.002	0.021	0.065	0.128	0.211	0.337	
-1.	0.007	-0.002	-0.007	-0.010	0.007	0.048	0.108	0.192	0.318	
-2.	0.005	-0.007	-0.016	-0.025	-0.012	0.028	0.083	0.166	0.293	

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 C(35.15.0) = 42.896 MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 10

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.		0.021	0.025	0.028	0.033	0.030	0.022	0.014	0.002	-0.013
25.		0.022	0.024	0.022	0.020	0.014	0.002	-0.009	-0.018	-0.027
20.		0.025	0.028	0.025	0.023	0.016	0.006	-0.005	-0.011	-0.013
15.		0.029	0.034	0.034	0.030	0.024	0.014	0.006	0.000	-0.001
10.		0.034	0.042	0.045	0.043	0.034	0.024	0.013	0.004	0.000
5.		0.039	0.051	0.056	0.052	0.039	0.021	0.004	-0.015	-0.026
0.		0.047	0.065	0.079	0.074	0.060	0.037	0.010	-0.016	-0.032
-1.		*****	*****	*****	*****	*****	*****	*****	*****	*****
-2.		*****	*****	*****	*****	*****	*****	*****	*****	*****

BROWN-AlLENTOfT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ACCERBONI-MOSETI
 C(35.15.0) = 42.902 MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 11

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	0.020	0.020	0.021	0.027	0.021	0.003	-0.022	-0.060	-0.112	
25.	0.017	0.011	0.002	-0.001	-0.006	-0.020	-0.038	-0.058	-0.084	
20.	0.016	0.008	-0.006	-0.009	-0.011	-0.017	-0.023	-0.026	-0.028	
15.	0.017	0.008	-0.010	-0.014	-0.014	-0.013	-0.008	0.000	0.015	
10.	0.019	0.009	-0.011	-0.015	-0.015	-0.010	-0.002	0.013	0.038	
5.	0.023	0.017	0.000	-0.000	0.002	0.009	0.023	0.041	0.076	
0.	0.026	0.021	0.004	-0.006	-0.009	-0.008	-0.004	0.008	0.041	
-1.	0.025	0.019	-0.002	-0.018	-0.027	-0.031	-0.034	-0.027	0.001	
-2.	0.024	0.015	-0.013	-0.039	-0.056	-0.068	-0.081	-0.082	-0.062	

BROWN-AlLENTOfT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PRITCHARD
 C(35.15.0) = 42.913 MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 12

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	0.243	0.116	-0.010	-0.054	-0.092	-0.152	-0.232	-0.338	-0.483
25.	0.215	0.061	-0.105	-0.157	-0.179	-0.203	-0.231	-0.267	-0.318
20.	0.221	0.072	-0.080	-0.113	-0.115	-0.116	-0.120	-0.128	-0.147
15.	0.236	0.101	-0.023	-0.035	-0.021	-0.007	0.002	0.000	-0.014
10.	0.248	0.122	0.017	0.023	0.047	0.072	0.086	0.087	0.076
5.	0.251	0.127	0.028	0.041	0.071	0.104	0.130	0.140	0.143
0.	0.248	0.123	0.023	0.040	0.083	0.135	0.180	0.217	0.258
-1.	0.248	0.122	0.024	0.043	0.091	0.150	0.200	0.247	0.300
-2.	0.247	0.122	0.027	0.049	0.102	0.169	0.226	0.284	0.349

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY WASHINGTON
 $C(35.15,0) = 42.698$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 13

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	0.007	0.015	-0.003	0.004	0.004	0.001	0.002	0.002	0.002
25.	0.064	0.017	-0.001	0.004	0.005	0.001	-0.001	-0.000	0.002
20.	0.066	0.019	-0.000	0.005	0.006	0.003	0.001	0.002	0.004
15.	0.067	0.019	-0.002	0.002	0.003	0.001	0.000	0.000	0.000
10.	0.068	0.020	-0.004	0.001	0.002	0.002	0.001	0.001	0.000
5.	0.069	0.021	-0.004	0.001	0.003	0.003	0.005	0.002	0.003
0.	0.070	0.022	-0.003	-0.001	0.001	0.003	0.002	0.000	0.005
-1.	0.070	0.022	-0.002	-0.001	0.001	0.004	0.002	0.001	0.007
-2.	0.070	0.022	-0.001	-0.002	0.001	0.005	0.001	0.001	0.008

BROWN-ALLENTOFT AVERAGE EXPERIMENTAL SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BROWN
 $C(35.15,0) = 42.896$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 14 (a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
<hr/>										
TEMPERATURE	DEGREES CELSIUS									
30.	0.034	-0.031	-0.061	-0.052	-0.032	-0.013	-0.002	0.009	0.035	
25.	0.038	-0.022	-0.048	-0.040	-0.023	-0.011	-0.005	-0.002	0.015	
20.	0.040	-0.017	-0.040	-0.033	-0.018	-0.007	-0.002	0.000	0.011	
15.	0.039	-0.017	-0.039	-0.033	-0.019	-0.008	-0.003	0.000	0.008	
10.	0.036	-0.020	-0.043	-0.038	-0.025	-0.014	-0.005	0.002	0.008	

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 $C(35,15,0) = 42.923$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 14 (b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
<hr/>										
TEMPERATURE										
DEGREES	CELSIUS									
30.		0.035	-0.029	-0.058	-0.049	-0.031	-0.014	-0.005	0.004	0.029
25.		0.040	-0.020	-0.046	-0.040	-0.025	-0.015	-0.012	-0.011	0.004
20.		0.041	-0.016	-0.038	-0.033	-0.021	-0.013	-0.010	-0.010	-0.001
15.		0.040	-0.015	-0.037	-0.033	-0.022	-0.014	-0.011	-0.010	-0.003
10.		0.037	-0.018	-0.041	-0.038	-0.028	-0.020	-0.013	-0.008	-0.002

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 $C(35,15,0) = 42.923$ MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 14(c)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE									
DEGREES CELSIUS									
30.	0.037	-0.024	-0.050	-0.040	-0.020	-0.003	0.007	0.016	0.041
25.	0.042	-0.016	-0.039	-0.031	-0.016	-0.005	-0.002	-0.001	0.014
20.	0.044	-0.011	-0.030	-0.023	-0.010	-0.002	0.001	0.001	0.011
15.	0.043	-0.010	-0.028	-0.022	-0.010	-0.002	0.002	0.004	0.013
10.	0.040	-0.012	-0.030	-0.025	-0.014	-0.005	0.003	0.009	0.018

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 C(35,15,0) = 42.923 MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 14(d)

	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE									
DEGREES CELSIUS									
30.	0.050	-0.000	0.000	0.031	0.065	0.096	0.118	0.138	0.175
25.	0.055	0.010	0.015	0.045	0.075	0.100	0.117	0.130	0.159
20.	0.059	0.019	0.031	0.062	0.092	0.117	0.135	0.150	0.177
15.	0.060	0.024	0.041	0.075	0.107	0.135	0.156	0.176	0.205
10.	0.060	0.027	0.049	0.086	0.119	0.151	0.180	0.207	0.241

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PERKIN - WALKER
 C(35,15,0) = 42.923 MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 15(a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE	DEGREES CELSIUS									
	30.	2.159	1.604	0.731	0.306	0.124	0.037	0.007	0.002	-0.002
	25.	1.319	0.919	0.334	0.091	0.012	-0.010	-0.004	0.006	0.004
	20.	1.166	0.821	0.321	0.114	0.042	0.015	0.011	0.010	0.001
	15.	1.143	0.820	0.348	0.142	0.062	0.023	0.007	0.000	-0.008
	10.	1.052	0.753	0.316	0.125	0.049	0.012	0.000	-0.000	0.005

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ROMDE
 $C(35,15,0) = 42.899$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 15(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE	DEGREES CELSIUS									
	30.	2.143	1.589	0.717	0.296	0.117	0.032	0.004	-0.001	-0.007
	25.	1.330	0.928	0.339	0.094	0.014	-0.009	-0.004	0.004	0.000
	20.	1.190	0.842	0.336	0.124	0.050	0.020	0.014	0.010	-0.002
	15.	1.169	0.843	0.365	0.155	0.071	0.028	0.010	0.001	-0.010
	10.	1.075	0.774	0.331	0.136	0.056	0.017	0.002	0.000	0.004

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ROMDE
 $C(35,15,0) = 42.899$ MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 15(c)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE	DEGREES CELSIUS									
	30.	2.126	1.572	0.704	0.286	0.110	0.029	0.001	-0.003	-0.010
	25.	1.336	0.933	0.341	0.096	0.015	-0.008	-0.004	0.003	-0.002
	20.	1.207	0.856	0.345	0.131	0.055	0.023	0.015	0.010	-0.004
	15.	1.185	0.858	0.376	0.162	0.076	0.032	0.012	0.001	-0.011
	10.	1.088	0.785	0.340	0.142	0.061	0.020	0.004	0.001	0.004

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RHODE
 $C(35,15,0) = 42.899$ MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 15(d)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE										
DEGREES	CELSIUS									
	30.	2.075	1.525	0.667	0.262	0.096	0.021	-0.002	-0.006	-0.017
	25.	1.331	0.925	0.332	0.089	0.010	-0.011	-0.006	0.001	-0.007
	20.	1.220	0.866	0.350	0.133	0.056	0.024	0.014	0.008	-0.009
	15.	1.194	0.866	0.380	0.166	0.079	0.034	0.012	-0.000	-0.014
	10.	1.079	0.778	0.336	0.141	0.061	0.020	0.004	0.001	0.004

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RHODE
 $C(35,15,0) = 42.899$ MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 16(a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES	CELSIUS									
30.	0.403	0.228	0.027	-0.015	-0.013	-0.005	-0.001	0.002	0.005	
25.	0.426	0.250	0.044	-0.004	-0.006	-0.002	-0.000	-0.000	0.001	
20.	0.445	0.268	0.059	0.006	-0.000	0.000	0.002	0.002	0.003	
15.	0.454	0.277	0.064	0.007	-0.001	-0.001	-0.000	0.000	0.001	
10.	0.442	0.267	0.057	0.001	-0.006	-0.004	-0.001	0.001	0.003	

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 $C(35,15.0) = 42.917$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 16(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	0.392	0.219	0.024	-0.013	-0.010	0.000	0.006	0.009	0.013	
25.	0.412	0.240	0.040	-0.005	-0.005	-0.001	0.001	0.001	0.003	
20.	0.429	0.256	0.052	0.003	-0.002	-0.000	0.001	0.001	0.003	
15.	0.436	0.263	0.057	0.004	-0.003	-0.002	-0.001	-0.001	0.000	
10.	0.422	0.251	0.049	-0.003	-0.008	-0.006	-0.003	-0.001	0.002	

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 $C(35,15.0) = 42.917$ MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 16(c)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE										
DEGREES	CFLSIUS									
30.		0.380	0.211	0.022	-0.012	-0.006	0.005	0.012	0.016	0.021
25.		0.399	0.230	0.035	-0.007	-0.005	0.000	0.003	0.004	0.005
20.		0.414	0.244	0.046	0.000	-0.003	-0.000	0.002	0.002	0.003
15.		0.418	0.249	0.050	0.001	-0.004	-0.002	-0.001	-0.001	0.001
10.		0.401	0.235	0.040	-0.006	-0.010	-0.006	-0.002	-0.000	0.002

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 C(35,15.0) = 42.917 MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 16(d)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE	DEGREES CELSIUS									
30.		0.348	0.187	0.012	-0.013	-0.001	0.014	0.023	0.029	0.036
25.		0.361	0.200	0.020	-0.012	-0.006	0.002	0.006	0.007	0.010
20.		0.368	0.208	0.028	-0.008	-0.006	-0.001	0.002	0.003	0.004
15.		0.364	0.206	0.027	-0.009	-0.008	-0.003	-0.000	0.000	0.002
10.		0.338	0.185	0.015	-0.018	-0.014	-0.006	-0.000	0.002	0.005

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY RIBE - HOWE
 C(35,15.0) = 42.917 MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 17(a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE	DEGREES CELSIUS									
	30.	-0.186	-0.231	-0.201	-0.113	-0.050	-0.012	0.000	0.002	0.003
	25.	-0.179	-0.218	-0.184	-0.100	-0.042	-0.010	-0.000	-0.001	0.003
	20.	-0.174	-0.210	-0.174	-0.091	-0.035	-0.006	0.002	0.002	0.005
	15.	-0.174	-0.209	-0.173	-0.091	-0.036	-0.007	0.002	0.000	0.001
	10.	-0.176	-0.214	-0.181	-0.099	-0.042	-0.010	0.001	0.001	0.001

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 C(35,15,0) = 42.929 MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 17(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES	CELSIUS									
	30.	-0.188	-0.235	-0.208	-0.121	-0.058	-0.017	-0.000	0.007	0.016
	25.	-0.181	-0.223	-0.194	-0.112	-0.054	-0.020	-0.006	0.000	0.013
	20.	-0.178	-0.217	-0.187	-0.107	-0.051	-0.020	-0.006	0.001	0.016
	15.	-0.178	-0.217	-0.189	-0.110	-0.055	-0.022	-0.008	-0.000	0.014
	10.	-0.181	-0.224	-0.200	-0.122	-0.065	-0.029	-0.010	0.001	0.017

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 C(35,15,0) = 42.929 MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 17(c)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE										
DEGREES CELSIUS										
30.		-0.190	-0.239	-0.215	-0.129	-0.065	-0.023	-0.002	0.010	0.027
25.		-0.184	-0.228	-0.204	-0.124	-0.066	-0.030	-0.012	-0.000	0.021
20.		-0.181	-0.223	-0.199	-0.122	-0.066	-0.033	-0.014	-0.000	0.025
15.		-0.181	-0.225	-0.203	-0.128	-0.073	-0.037	-0.017	-0.001	0.026
10.		-0.185	-0.233	-0.217	-0.143	-0.086	-0.047	-0.021	0.001	0.032

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 $C(35, 15, 0) = 42.929$ MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 17(d)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE										
DEGREES CELSIUS										
30.	-0.196	-0.249	-0.235	-0.154	-0.090	-0.043	-0.014	0.011	0.046	
25.	-0.191	-0.242	-0.230	-0.157	-0.100	-0.060	-0.033	-0.006	0.036	
20.	-0.189	-0.239	-0.230	-0.161	-0.107	-0.068	-0.038	-0.007	0.042	
15.	-0.191	-0.244	-0.240	-0.174	-0.120	-0.078	-0.044	-0.007	0.050	
10.	-0.197	-0.255	-0.261	-0.198	-0.141	-0.093	-0.051	-0.004	0.065	

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BENNETT 1
 $C(35, 15, 0) = 42.929$ MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 18(a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
25.	-0.001	-0.002	-0.004	-0.007	-0.008	-0.011	-0.013	-0.016	-0.018	-0.018
20.	-0.001	-0.001	-0.002	-0.003	-0.004	-0.006	-0.006	-0.008	-0.009	-0.009
15.	-0.000	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
10.	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.008

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ZDLP
 $C(35.15,0) = 42.896$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 18(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
25.	-0.001	-0.002	-0.004	-0.007	-0.008	-0.011	-0.013	-0.016	-0.018	-0.018
20.	-0.001	-0.001	-0.002	-0.003	-0.004	-0.006	-0.006	-0.008	-0.009	-0.009
15.	-0.000	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	0.000	-0.000
10.	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008	0.008

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ZDLP
 $C(35.15,0) = 42.896$ MILLIMHOS
 PRESSURE IS 1000.0 DECIBARS

TABLE 18(c)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001
25.	-0.001	-0.002	-0.004	-0.007	-0.008	-0.011	-0.013	-0.016	-0.018
20.	-0.001	-0.001	-0.002	-0.003	-0.004	-0.006	-0.006	-0.008	-0.009
15.	-0.000	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000
10.	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
MINUS THE SALINITY VALUES CALCULATED BY ZDLP
C(35,15.0) = 42.856 MILLIMHOS
PRESSURE IS 2000.0 DECIBARS

TABLE 18(d)

TEMPERATURE DEGREES CELSIUS	SALINITIES (0/00)								
	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30.	-0.000	-0.000	-0.000	-0.000	-0.001	-0.001	-0.001	-0.001	-0.001
25.	-0.001	-0.002	-0.004	-0.007	-0.009	-0.011	-0.013	-0.016	-0.018
20.	-0.001	-0.001	-0.002	-0.003	-0.004	-0.006	-0.006	-0.008	-0.009
15.	-0.000	0.000	0.000	-0.000	0.000	-0.000	0.000	0.000	-0.000
10.	0.000	0.001	0.002	0.003	0.004	0.005	0.006	0.007	0.008

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
MINUS THE SALINITY VALUES CALCULATED BY ZDLP
C(35,15.0) = 42.856 MILLIMHOS
PRESSURE IS 5000.0 DECIBARS

TABLE 19(a)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	0.002	0.004	0.010	0.017	0.022	0.027	0.033	0.038	0.044	
25.	-0.000	-0.000	-0.000	-0.000	0.000	-0.001	-0.000	-0.001	-0.001	
20.	-0.000	-0.001	-0.001	-0.003	-0.004	-0.005	-0.005	-0.006	-0.007	
15.	-0.000	0.000	0.000	-0.000	0.000	-0.000	0.000	-0.000	-0.000	
10.	0.001	0.001	0.002	0.004	0.005	0.006	0.008	0.009	0.010	

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 $C(35,15.0) = 42.896$ MILLIMHS
 PRESSURE IS 0.0 DECIBARS

TABLE 19(b)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.	-0.000	0.000	0.003	0.008	0.013	0.021	0.031	0.042	0.056	
25.	-0.003	-0.006	-0.013	-0.016	-0.017	-0.016	-0.013	-0.007	0.001	
20.	-0.004	-0.008	-0.017	-0.023	-0.025	-0.025	-0.021	-0.016	-0.008	
15.	-0.005	-0.009	-0.018	-0.023	-0.024	-0.023	-0.017	-0.009	0.003	
10.	-0.005	-0.010	-0.019	-0.023	-0.023	-0.019	-0.011	0.000	0.017	

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 $C(35,15.0) = 42.896$ MILLIMHS
 PRESSURE IS 1000.0 DECIBARS

TABLE 19(c)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES	CELSIUS									
	30.	-0.001	-0.002	0.000	0.007	0.015	0.028	0.043	0.062	0.087
	25.	-0.005	-0.010	-0.019	-0.023	-0.021	-0.017	-0.007	0.006	0.024
	20.	-0.007	-0.013	-0.026	-0.032	-0.032	-0.028	-0.018	-0.004	0.017
	15.	-0.007	-0.015	-0.028	-0.034	-0.033	-0.025	-0.012	0.007	0.034
	10.	-0.008	-0.016	-0.031	-0.036	-0.033	-0.022	-0.004	0.021	0.056

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 $C(35,15,0) = 42.896$ MILLIMHOS
 PRESSURE IS 2000.0 DECIBARS

TABLE 19(d)

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES	CELSIUS									
	30.	0.002	0.005	0.021	0.047	0.076	0.115	0.161	0.214	0.280
	25.	-0.004	-0.006	-0.004	0.010	0.032	0.063	0.103	0.152	0.215
	20.	-0.006	-0.010	-0.012	0.001	0.023	0.056	0.102	0.157	0.229
	15.	-0.007	-0.012	-0.013	0.003	0.030	0.072	0.126	0.193	0.281
	10.	-0.007	-0.013	-0.014	0.006	0.040	0.091	0.158	0.239	0.345

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY FEDEROV
 $C(35,15,0) = 42.896$ MILLIMHOS
 PRESSURE IS 5000.0 DECIBARS

TABLE 20

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE										
DEGREES CELSIUS										
30.		0.002	-0.002	-0.012	0.004	0.016	0.019	0.011	0.002	-0.007
25.		0.002	-0.001	-0.017	-0.005	-0.001	-0.002	-0.010	-0.018	-0.022
20.		0.005	0.003	-0.012	-0.006	0.000	-0.002	-0.006	-0.011	-0.008
15.		0.009	0.009	-0.005	0.001	0.007	0.006	0.002	0.000	0.006
10.		0.012	0.015	0.004	0.008	0.012	0.010	0.006	0.004	0.010

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY ACCERBONI-MOSETI
 $C(35,15.0) = 42.902$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 21

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
TEMPERATURE DEGREES CELSIUS										
	30.	-0.000	-0.008	-0.019	-0.002	0.007	-0.001	-0.025	-0.060	-0.105
	25.	-0.003	-0.015	-0.038	-0.029	-0.021	-0.025	-0.039	-0.058	-0.079
	20.	-0.004	-0.017	-0.044	-0.037	-0.027	-0.024	-0.024	-0.026	-0.023
	15.	-0.004	-0.018	-0.049	-0.043	-0.031	-0.021	-0.012	0.000	0.022
	10.	-0.003	-0.018	-0.052	-0.050	-0.038	-0.025	-0.009	0.013	0.047

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY PRITCHARD
 $C(35,15.0) = 42.913$ MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 22

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE										
DEGREES CELSIUS										
30.		0.222	0.088	-0.051	-0.083	-0.107	-0.156	-0.234	-0.338	-0.476
25.		0.193	0.034	-0.145	-0.186	-0.193	-0.207	-0.232	-0.267	-0.313
20.		0.199	0.045	-0.119	-0.141	-0.131	-0.123	-0.121	-0.128	-0.142
15.		0.213	0.074	-0.062	-0.064	-0.038	-0.015	-0.002	0.000	-0.006
10.		0.224	0.094	-0.024	-0.012	0.024	0.057	0.078	0.087	0.086

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY WASHINGTON
 C(35,15,0) = 42.698 MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 23

		SALINITIES (0/00)								
		1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196

TEMPERATURE										
DEGREES	CELSIUS									
	30.	0.041	-0.012	-0.044	-0.026	-0.010	-0.002	-0.001	0.002	0.009
	25.	0.043	-0.009	-0.040	-0.024	-0.009	-0.003	-0.002	-0.000	0.007
	20.	0.045	-0.006	-0.038	-0.023	-0.010	-0.004	-0.001	0.002	0.009
	15.	0.045	-0.006	-0.040	-0.027	-0.015	-0.008	-0.004	0.000	0.008
	10.	0.045	-0.008	-0.045	-0.034	-0.021	-0.012	-0.006	0.001	0.010

INTERNATIONAL OCEANOGRAPHIC TABLE SALINITY VALUES IN PARTS PER THOUSAND
 MINUS THE SALINITY VALUES CALCULATED BY BROWN
 C(35,15,0) = 42.896 MILLIMHOS
 PRESSURE IS 0.0 DECIBARS

TABLE 24

T\S	1.927	4.163	9.858	15.468	20.300	25.332	30.200	35.000	40.196
30	.99959	1.0003	1.00017	.99999	.99986	.99983	.99996	1.00000	1.00001
25	.99963	1.00003	1.00008	.99995	.99987	.99987	.99989	1.00000	1.00004
20	.99967	.99998	.99993	.99996	.99994	.99996	.99992	1.00000	1.00005
15	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000	1.00000
10	1.00063	1.00038	1.00023	1.00033	1.00023	1.00022	1.00009	1.00000	.99994

Values of $R_T = C(S, T, 0) / C(35, T, 0)$ from Unesco Tables normalized at 15° C., divided by values of R_T (also normalized at 15°C.) from Brown and Allentofts' data.

TABLE 25

Salinities Computed From Formulae Using Input

 $C = 42.80 \text{ mmhos cm}^{-1}$, $T = 15.0^\circ \text{ C.}$, $P = 0 \text{ db}$

Perkin-Walker	34.887
Rohde	34.910
Ribe-Howe	34.893
Bennett	34.882
Mosetti-Accerboni	34.906
Pritchard	34.897
Wash.	35.094
ZDLP	34.912

APPENDIX I

Fortran IV, double precision, listing of salinity formulae.

All routines return values of salinity (‰) given values of in situ C (mmho/cm), T(°C.), P(db). Those routines using iteratively the pressure correction function BRAD need in addition a 'first-guess' value of salinity (‰). For the iterative routines the COMMON variables must be assigned appropriate values.

FORMULA DUE TO PERKINS AND WALKER

END

FORMULA DUE TO RIBE AND HOWE

END

C
C
C
C
C
C
C
C
C

POLYNOMIAL DUE TO ROHDE AT KIEL

CCCCCCCC

FORMULA DUE TO BENNETT

```

      IMPLICIT REAL*8 (A-H,O-Z)
      X=C/(1.D0+(P*(1.6055D-5+P*(-5.3441D-10+P*5.026D-15))))/
B      (1.D0+T*(3.14006D-2+T*3.1004D-4)))
      BENT=((5.523D-3+T*(-5.416D-5-T*5.12D-7)+(5.36D-7*T
B      -2.33D-5)*X)*X+1.D0)*X
      BENT=BENT/(9.46603D-1+T*(3.02246D-2+T*(1.73901D-4+T*
B      (-1.21425D-6-T*1.9421D-8))))
      RETURN
      END

```

DOUBLE PRECISION FUNCTION ZDLP(T,P,C,S)

RETURNS A SALINITY VALUE GIVEN:

PRESSURE 'P' IN DBARS
TEMPERATURE 'T' IN DEGREES CELSIUS
CONDUCTIVITY 'C' IN MMHO/CM
FIRST GUESS SALINITY 'S' IN 0/00

ITERATIVE FORMULA DUE TO ZDLP, SEVASTOPOL

IMPLICIT REAL*8 (A-H,J,O-Z)

COMMON PER, ERR, S1, N, I, EXCEED

LOGICAL EXCEED

F(P)=P*(1.042D-3+P*(-3.3913D-8+P*3.3D-13))

G(T)=1.5192D0+T*(-4.5302D-2+T*(8.3089D-4-T*7.9D-6))

H(P)=4.D-4+P*(2.577D-5-P*2.492D-9)

J(T)=1.D0+T*(-1.535D-1+T*(8.276D-3-T*1.657D-4))

S1=S

I=0

DELT=T-1.5D1

RTP=C/(4.2896D1*(1.D0+DELT*(2.28649D-2+DELT*(7.884D-5
Z +DELT*(-5.704D-7+DELT*1.664D-8))))

X1=1.D-2*(G(T)*F(P)+H(P)*J(T))

10 I=I+1

RT=RTP/(1.D0+X1*(1.D0+(6.95D-3-7.6D-5*T)*(3.5D1-S1)))

R15=RT*(1.D0+1.D-5*(RT-1.D0)*DELT*(9.67D1+RT*(-7.2D1+RT
Z *(3.73D1-DELT*2.1D-1))+DELT*(-6.3D-1)))

ZDLP=-8.996D-2+R15*(2.82972D1+R15*(1.280832D1+R15*

Z (-1.067869D1+R15*(5.98624D0-R15*1.32311D0)))

ERR=DABS(ZDLP-S1)

IF (ERR.LT.PER) RETURN

IF (I.LT.N) GOTO 15

EXCEED=.TRUE.

RETURN

15 S1=ZDLP

GOTO 10

END

DOUBLE PRECISION FUNCTION FED (T,P,C)

RETURNS A SALINITY VALUE GIVEN:

PRESSURE 'P' IN DBARS

TEMPERATURE 'T' IN DEGREES CELSIUS

CONDUCTIVITY 'C' IN MMHO/CM

FORMULA DUE TO FEDEROV

IMPLICIT REAL*8 (A-H,O-Z)

CINT = 42.896D0

T15 = 15.D0 - T

T15SQ = T15*T15

CST0 = C / (1.0D0 + P * 1.0D-2 * (9.84D-4 + (2.69D-5 * T15) +
1 (5.1D-7 * T15SQ)))

C35T0 = CINT * (1.0D0 - 2.285D-2 * T15 + 8.1D-5 * T15SQ)

RT = CST0/C35T0

RTSQ = RT*RT

DEL15 = 1.0D-5 * RT * (1.0D0 - RT) * T15 *
1 (9.67D1 - 7.2D1 * RT + 3.73D1 * RTSQ +
2 (6.3D-1 + 2.1D-1 * RTSQ) * T15)

R15 = RT + DEL15

R15SQ = R15*R15

R15FT = R15SQ*R15SQ

FED = -8.996D-2 + 2.82972D1 * R15
1 + 1.280832D1 * R15SQ
2 -1.067869D1 * R15SQ*R15
3 + 5.98624D0 * R15FT
4 - 1.32311 * R15FT * R15

RETURN
END

DOUBLE PRECISION FUNCTION ACRMAS(T,P,C,S)

RETURNS A SALINITY VALUE GIVEN:

PRESSURE 'P' IN DBARS
TEMPERATURE 'T' IN DEGREES CELSIUS
CONDUCTIVITY 'C' IN MMHO/CM
FIRST GUESS SALINITY 'S' IN 0/00

BRADSHAW - SCHLEICHER PRESSURE CORRECTION
FUNCTION 'BRAD' USED ITERATIVELY

FORMULA DUE TO ACCERBONI AND MOSETTI

IMPLICIT REAL*8 (A-H,O-Z)
COMMON PER, ERR, S1, N, I, EXCEED
LOGICAL EXCEED

S1=S

IF (S1.LT.0.D0) S1=0.D0

I=0

IF (T.GE.0.D0) GOTO 9

FORMULA CANNOT COMPUTE AN APPROXIMATION WHEN T < 0.0

5 ACRMAS=5.D2

RETURN

9 FACT=2.1923D0+1.2842D-1*DEXP(2.9D-3*T)*T**1.032D0/(1.D0+
A T**3.2D-2)

10 I=I+1

CST0=BRAD(C,T,P,S1)

ACRMAS=(CST0/FACT)*((1.D0+S1**1.243D-1)*DEXP(9.78D-4*S1+
A 1.65D-5*(S1-3.5D1)*(T-2.D1))

ERR=DABS(ACRMAS-S1)

IF (ERR.LT.PER) RETURN

IF (I.LT.N) GOTO 15

13 EXCEED=.TRUE.

RETURN

15 S1=ACRMAS

IF (S1.GE.0.D0) GOTO 10

GOTO 5

END

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C      DOUBLE PRECISION FUNCTION PUCHRD(T,P,C,S)
C
C      RETURNS A SALINITY VALUE GIVEN:
C
C      PRESSURE 'P' IN DBARS
C      TEMPERATURE 'T' IN DEGREES CELSIUS
C      CONDUCTIVITY 'C' IN MMHO/CM
C      FIRST GUESS SALINITY 'S' IN 0/00
C
C      BRADSHAW - SCHLEICHER PRESSURE CORRECTION
C      FUNCTION 'BRAD' USED ITERATIVELY
C
C      FORMULA DUE TO PRITCHARD
C
      IMPLICIT REAL*8 (A-H,O-Z)
      COMMON PER, ERR, S1, N, I, EXCEED
      LOGICAL EXCEED
      S1=S
      I=0
      B=1.3855D0+T*(-4.6485668D-2+T*(1.4887785D-3
P      +T*(-6.3083433D-5+T*
P      (2.5144517D-6+T*(-5.9600245D-8+T*5.7778085D-10))))))
10    I=I+1
      CST0=BRAD(C,T,P,S1)
      IF (CST0.GT.0.D0) GOTO 12
      PUCHRD=5.D2
      RETURN
12    A=3.6996D-1/(CST0**(-1.07D0)-7.464D-4)
      PUCHRD=1.80655D0*A*B
      ERR=DABS(PUCHRD-S1)
      IF (ERR.LT.PER) RETURN
      IF (I.LT.N) GOTO 15
      EXCEED=.TRUE.
      RETURN
15    S1=PUCHRD
      GOTO 10
      END

```

DOUBLE PRECISION FUNCTION WASH(T,P,C,S)

RETURNS A SALINITY VALUE GIVEN:

PRESSURE 'P' IN DBARS
TEMPERATURE 'T' IN DEGREES CELSIUS
CONDUCTIVITY 'C' IN MMHO/CM
FIRST GUESS SALINITY 'S' IN 0/00

BRADSHAW - SCHLEICHER PRESSURE CORRECTION
FUNCTION 'BRAD' USED ITERATIVELY

ROUTINE USED AT THE UNIVERSITY OF WASHINGTON (COLLIAS)

IMPLICIT REAL*8 (A-H,O-Z)

COMMON PER, ERR, S1, N, I, EXCEED

LOGICAL EXCEED

S1=S

I=0

10 I=I+1

C1=BRAD(C,T,P,S1)*1.D-3

WASH=-5.05D-1+C1*(1.115294D3+C1*3.680067D3)+T*(C1*
W (-3.5142D1-1.20291D2*C1)+T*(8.6D-1*C1+T*(C1*
W (-1.1D-2+C1*4.8D-2))))

ERR=DABS(WASH-S1)

IF (ERR.LT.PER) RETURN

IF (I.LT.N) GOTO 15

EXCEED=.TRUE.

RETURN

15 S1=WASH

GOTO 10

END

DOUBLE PRECISION FUNCTION BROWN(T,P,C,S)

RETURNS A SALINITY VALUE GIVEN:

PRESSURE 'P' IN DBARS
TEMPERATURE 'T' IN DEGREES CELSIUS
CONDUCTIVITY 'C' IN MMHO/CM
FIRST GUESS SALINITY 'S' IN 0/00

BRADSHAW - SCHLEICHER PRESSURE CORRECTION
FUNCTION 'BRAD' USED ITERATIVELY

REFERENCE:

THE DETERMINATION OF SALINITY FROM CONDUCTIVITY,
TEMPERATURE AND PRESSURE MEASUREMENTS.

J. E. JAEGER, CONFERENCE AND WORKSHOP PROCEEDINGS,
JANUARY 1973, PLESSY ENVIRONMENTAL SYSTEMS.

IMPLICIT REAL*8(A-H,O-Z)

COMMON PER, ERR, S1, N, I, EXCEED

LOGICAL EXCEED

C(35,15,0) = 42.896

CINT = 42.89600

S1 = S

I = 0

10 I = I + 1

H = 6.7654668D-1 + 2.0131661D-2*T + 9.9886585D-5*T*T

1 - 1.9426015D-7*T**3 - 6.7249142D-9*T**4

H = 1.D0/H

CST0 = BRAD(C,T,P,S1)

RT = (CST0/CINT)*H

R15 = RT + (RT - 1)*(1.75D-2*RT - 4.5D-3*RT*RT)

1 *(-1.D0 + 8.D-2*T - 8.9D-4*T*T)

BROWN = -2.1977D-1 + 2.981964D+1*R15 + 7.95554D0*R15*R15

1 -3.88602D0*R15**3 + 1.5653D0*R15**4 - 2.3469D-1*R15**5

ERR = DABS(BROWN - S1)

IF (ERR.LT.PER) RETURN

IF (I.LT.N) GO TO 15

EXCEED = .TRUE.

RETURN

15 S1 = BROWN

GO TO 10

END

DOUBLE PRECISION FUNCTION BRAD(C,T,P,S)

RETURNS THE VALUE OF CONDUCTIVITY AT (S,T,0) GIVEN:

THE SALINITY 'S'

THE TEMPERATURE 'T'

THE PRESSURE 'P'

THE CONDUCTIVITY 'C' AT (S,T,P)

EQUATION DUE TO BRADSHAW AND SCHLEICHER

IMPLICIT REAL*8 (A-Z)

F(P)=P*(1.042D-3+P*(-3.3913D-8+P*3.3D-13))

G(T)=1.5192D0+T*(-4.5302D-2+T*(8.3089D-4-T*7.9D-6))

H(P)=4.D-4+P*(2.577D-5-P*2.492D-9)

J(T)=1.D0+T*(-1.535D-1+T*(8.276D-3-T*1.657D-4))

L(T)=6.95D-3-T*7.6D-5

IF (DABS(P).GT.1.D-5) GOTO 10

BRAD=C

RETURN

10 FACT=1.D-2*(G(T)*F(P)+H(P)*J(T))

BRAD=C/(1.D0+FACT*(1.D0+L(T)*(3.5D1-S)))

RETURN

END

